

• MIDDLE EASTERN NUCLEAR ARSENALS • CRISIS IN CONTRACEPTION •

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TechnologyReview

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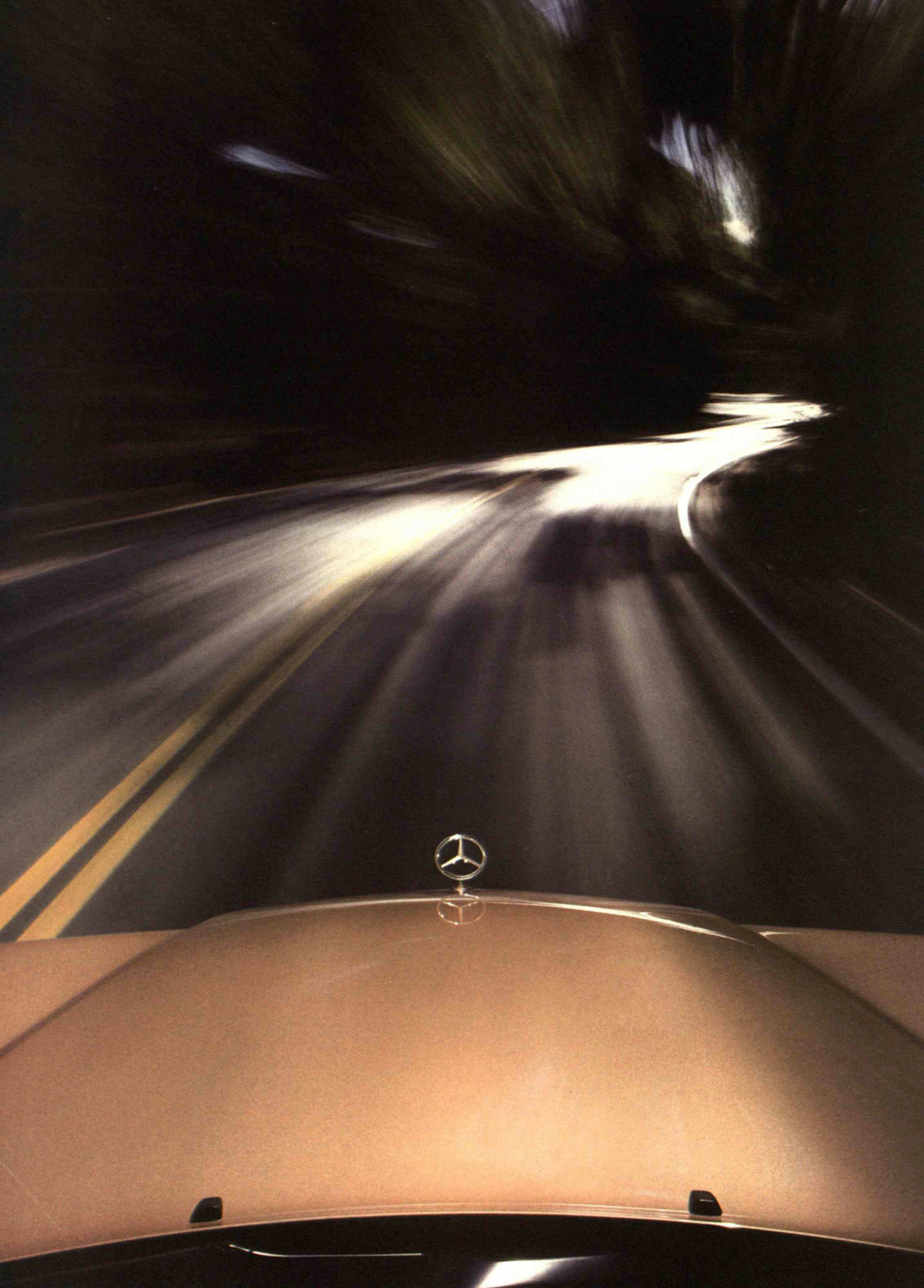
COMPUTERS: A THIRD WORLD COUNTRY BUILDS ITS OWN



technology review

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THE MERCEDES-BENZ 190 CLASS: THE SUBTLE DIFFERENCE BETWEEN MASTERING THE ROAD AND MERELY COPING WITH IT.

The road passes beneath you as always, but the sensations are markedly different. So is your state of mind. This is your first experience with a 190 Class sedan, but already you are driving with calm confidence. The car has earned your trust.

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Suddenly the pavement deteriorates into washboard gravel, but the car tracks steadfastly ahead, curiously unfazed by the change in terrain. It occurs to you that you have yet to hear a squeak or rattle. The engine remains almost subliminally quiet, wind noise a faint whisper when you hear it at all. You normally feel an urge to stretch your legs after sitting for so long, but now you feel the urge to keep driving.



Even if you chose the automatic transmission, you still find it easy to shift manual-style when the mood strikes, locating each gear by feel without glancing downward. Your driving has become pleurably instinctive, as driving at its best should be.

This ostensibly mystical exaltation of the driving experience springs from such technological advances as "the most sophisticated steel suspension ever put into volume production" (Britain's *Car Magazine*). And the simple fact that a 190 Class sedan is built like every Mercedes-Benz—not one ergonomic or safety principle sacrificed for the sake of cosmetic luxury or digital showmanship. Every detail of construction and assembly meeting universally envied standards.

The result is a sedan that does not "challenge" you in the macho sports-sedan tradition, but rather serves as a congenial and supremely capable ally—at once exciting and obedient, responsive and considerate. The road provides challenge enough.



Engineered like no other car in the world

Improved access to a new generation of giant Intelsat satellites is planned. Intelsat VI, designed and built by Hughes Aircraft Company, is a series of five of the world's largest, most powerful commercial communications satellites. Each will have the capacity to carry 120,000 telephone calls and at least three television channels simultaneously. Making this possible is the use of very advanced digital modulation techniques. Design changes, the result of a system modification contract from the International Telecommunications Satellite Organization (INTELSAT), also will more than double the downward signal capacity of the satellite's spot beams, permitting greater coverage of North America and more connections with Europe. Called the satellite of the 21st century, each satellite in the Intelsat VI series stands 39 feet high and will use terminals as small as two feet in diameter. The first Intelsat, built by Hughes more than 20 years ago, was 4½ feet high and required Earth terminals nearly 100 feet in diameter.

An infrared viewer found potential trouble spots in a large pharmaceutical plant during a five-day survey of a 57-building complex. Hughes' Probeye® infrared viewer scanned 5,000 areas of potential trouble and pinpointed 60 hot spots, most of which were in the electrical systems and motors. For example, the Probeye unit showed a heat buildup of 120°C at three cartridge-type fuses. Also, a 75°C rise was discovered at another electrical connection. The fuse could have failed during a production run, resulting in costly downtime. The Probeye viewer sees heat the way a camera sees light, converting it instantly into an image seen through the eyepiece.

Infantry squads can maintain communications under polar conditions thanks to the Hughes AN/PRC-104 manpack radio, now the standard U.S. military field-communications system. It weighs only 14 pounds yet its lithium batteries provide enough power for voice communications at ranges of more than 1000 miles. It operates reliably at temperatures well below -50 degrees centigrade and can be used in total darkness by operators wearing the thickest mittens. Designed to meet a military specification of 2500 hours between failures, its actual record in the field far exceeds that requirement with an average of 4000 hours of fault-free operation.

U.S. Navy F/A-18 pilots will be able to see as though it were daylight while conducting low-altitude, high-speed missions at night using a Thermal Imaging Navigation Set (TINS) system developed by Hughes for McDonnell Aircraft Company. The TINS features a thermal sensor that displays a TV-like image of the terrain ahead on the pilot's head-up display. Ground objects and terrain are clearly viewed in a one-to-one real scene projection. Pilots are able to see in total darkness and through battlefield smoke and haze. TINS will be carried in a pod and mounted in a fixed, forward-looking position. Hughes will build five development systems, one of which will be used for flight testing. Delivery of these units is scheduled for fall of 1987.

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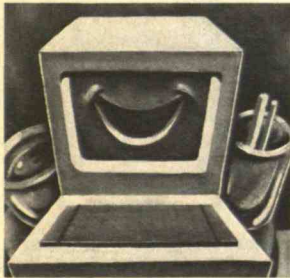
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FIRST LINE

FROM THE EDITOR

The Diversity Dilemma

EDITORS walk a tightrope. On one side is the risk that their magazines are too predictable, dealing with the obviously timely and important topics in the fields to which they are dedicated. The alternative is to ignore such questions to concentrate on the unexpected—issues that are more subtle or less discussed.

Technology Review tends toward the latter. We give our readers credit for curiosity about all the ways in which technology affects people and their affairs. Perhaps more than most, this issue of the magazine demonstrates that desire to reach for diversity and the unexpected.

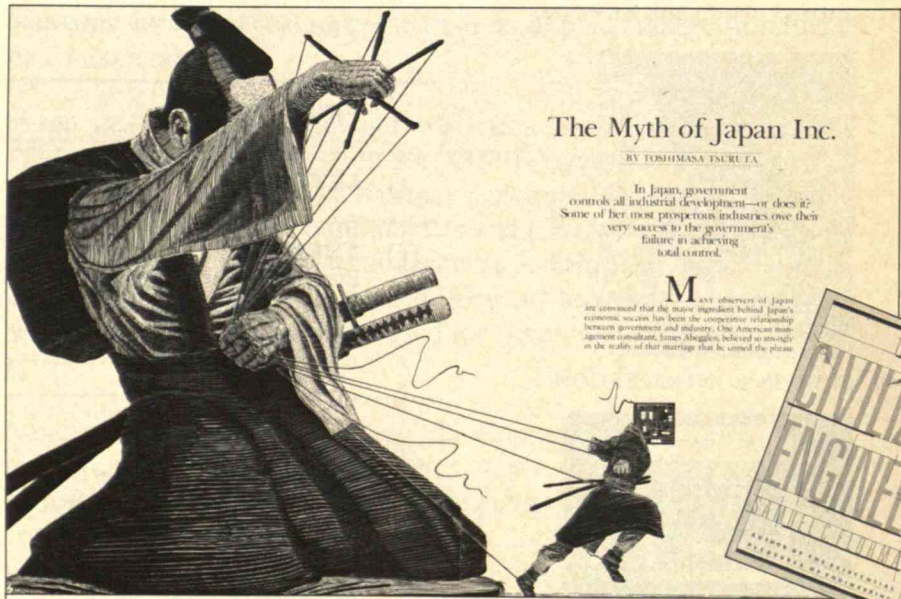
Antonio José J. Botelho examines an issue of current controversy—protectionism and the constraint of technology transfer—from a viewpoint seldom seen in the United States. A native Brazilian graduate student in political science at M.I.T., he writes from his country's perspective on its determination to develop and protect an indigenous computer industry.

Though some of our readers may not think of them that way, contraceptive devices are by definition technology—applications of scientific understanding to human need. Elizabeth B. Connell, professor of gynecology and obstetrics at

Emory University, shows that this is another arena in which policy is limiting the discovery and application of technology. New technology must be pursued, writes Connell, even while policies governing the use of present technology must be changed if people's needs are to be fulfilled and today's contraceptive crisis alleviated.

A third article brings a special perspective to a little-understood issue. British physicist Frank Barnaby, chairman of the British anti-nuclear group Just Defense, writes about the dangers of nuclear proliferation in the Middle East. He spent two days with Mordechai Vanunu, whose revelations about the Israeli nuclear-weapons program startled many observers last October, before Vanunu was abducted and incarcerated in Israel. Barnaby describes the technical reasons why he was convinced of Vanunu's story. There are also several heretofore-unpublished photographs obtained by Barnaby, including one of the Israeli facilities for producing lithium.

John I. Mattill



We take pleasure in congratulating two of our regular contributors. Samuel C. Florman, who writes for *Technology Review* four times a year, is the author of a new book entitled *The Civilized Engineer* (St. Martin's Press, 1987). Included are several

essays adapted from our pages. And Christopher Bing's illustration for "The Myth of Japan Inc." (July 1983) has been chosen by Steven Heller of Pushpin Editions for reproduction in his forthcoming *Encyclopedia of Visual Ideas*.

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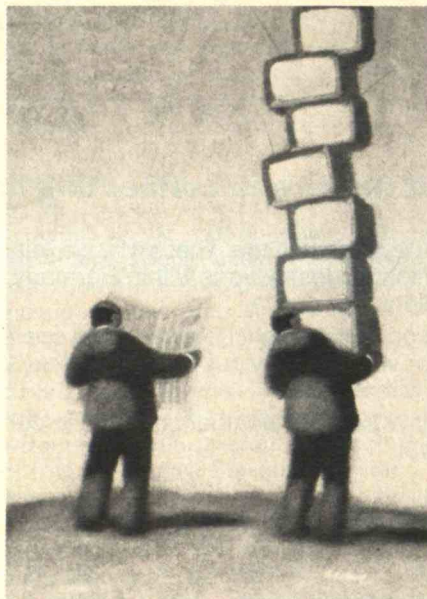
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LETTERS

Controlling the Airwaves, Relocating the Navajo



REGULATING BROADCAST

In "The Fairness Doctrine Is Shackling Broadcast" (November/December 1986, page 44), Hugh Carter Donahue should have started from the premise that those who operate radio and television stations are mere licensees. The airwaves are owned by the people.

I would like to see TV and radio licenses auctioned off. The government might then receive at least 25 percent of the gross revenues and insist on public monitoring of programming.

HARRY J. NICHOLS
St. Louis, Mo.

Hugh Carter Donahue cites a growing list of new telecommunications technologies, arguing that the sheer quantity of resulting channels is sufficient to justify deregulation of broadcast. But he neglects to mention that the new technologies are largely in the same hands as the old ones. He later remarks that newspapers, which already are deregulated, are usually de facto monopolies in their respective communities. If this is true, why does quantity of channels even matter?

Unfortunately, Donahue advances few tangible examples of how the Fairness Doctrine has kept the broadcast media from speaking out. And he fails to note that ever since broadcasters have been freed from FCC news and public-affairs requirements, they have chosen to feature game shows and shop-at-home programs

in place of the traditional features. Does such fare represent the diversity toward which he would have society strive?

Perhaps the founding fathers did not anticipate that by constraining even reasonable government involvement with the press, they would create local and regional monopolies and national oligopolies. (Or perhaps, being landowning aristocrats, they did.)

In any case, Americans need not replicate the oversights of the past. The government should be allowed to take its role as the public's advocate in an increasingly private marketplace of ideas.

ROBERT JACOBSON
Sacramento, Calif.

The author responds:

Mr. Nichols seems to be saying that as licensees of the airwaves, broadcasters do not deserve the same First Amendment rights as owners of magazines and newspapers. But the lack of such rights limits the ability of the electronic media to report news and express editorial views.

Mr. Jacobson ignores more than he explains. Intense competition among broadcast journalists is increasing the flow of news to the public. And because of satellites, news can come in from reporters all over the world.

Some stations do air game shows and shop-at-home programs. But game shows are usually lead-ins to early-evening news broadcasts, and as a rule shop-at-home programs do not replace news. They appear on UHF or cable channels that happen to carry little if any news or public-affairs programming.

Finally, the founding fathers knew they were taking chances. George Washington described some journalists as "infamous scribblers," and Thomas Jefferson wryly observed that "even the least informed of the people have learnt that nothing in a newspaper is to be believed." If a certain level of risk is acceptable in print, why not in broadcast?



INDIANS AND INDUSTRY

"Moving Those Indians into the Twentieth Century" by Hollis Whitson and Martha Roberge (July 1986, page 46) is

full of untruths about Peabody Coal Co.

The company is not involved in the federal government's relocation of Navajo and Hopi from the Big Mountain Joint Use Area (JUA). Nor was the company ever involved in lobbying for the law that established the relocation program in 1974.

Peabody has no leases to mine coal in the disputed area, nor has it any intention of ever mining coal there. Moreover, the company has not "strip-mined 65,000 acres next to the JUA," as the caption on page 49 attests. There is coal under only 14,000 acres of the land leased from the tribes; that's about seven-tenths of a percent of the Black Mesa's surface. Peabody mines approximately 400 acres annually on the Black Mesa.

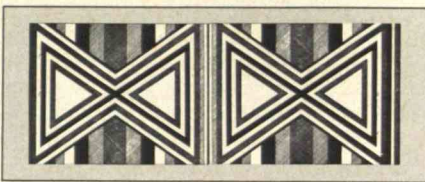
Peabody is the largest private employer of Indians on the Black Mesa. Some 800 Native Americans work at the two mines there, earning an average of about \$35,000 annually at rates of \$15.90 to \$17.49 an hour—more than \$30 million a year. In fact, most of the \$95 million a year Peabody pays in wages, benefits, taxes, royalties, and purchased services flows into the local Indian communities. Peabody's taxes make up 90 percent of the budget of the Kayenta School District on the reservation, and more than \$51 million in royalties goes to the Navajo and Hopi under leases signed in the mid-1960s.

Peabody has spent \$80 million to reclaim or improve land on the Black Mesa to meet federal requirements, at costs ranging from \$8,000 to \$20,000 an acre. Research has shown that this area will provide two to three times more grazing forage than it had originally.

Finally, while Harrison Loesch worked for Peabody Coal between 1976 and 1981, he never dealt with the Navajo or Hopi tribes, or with the company's Arizona operations. And Peabody never employed John Boyden or his law firm. The annual national directory compiled by Martindale-Hubbell, Inc., may suggest otherwise, but I understand that this company takes no action to check the accuracy of the listings it receives from lawyers and legal firms. Contacted several times by the Indian Land Research Center, Peabody has on each occasion denied its having employed Boyden or his firm.

RONALD H. GREENFIELD
St. Louis, Mo.

Ronald H. Greenfield is director of public affairs for Peabody Coal Co.



The authors respond:

We have little disagreement with what Mr. Greenfield says. However, our basic message is unaffected: relocation destroys the Indians' land-based culture, and strip-mining is not possible without relocation. It is true that Peabody fulfills all contractual obligations to its employees, the government, and the tribes. What we do not know is the closely guarded secret: how much profit the company has made on the ill-conceived lease agreement.

Despite Peabody's federally mandated reclamation projects, not a single land or water system has been successfully restored yet. Despite federal reclamation

standards, the National Academy of Sciences predicts that strip-mining in arid regions will result in their eventual designation as "national sacrifice areas."

Though Peabody Coal's total lease acreage is 65,000 acres, we realize that not all of this land has been mined; the caption that states to the contrary was written by a *Technology Review* editor, not by us.

We stand by our statement that Peabody Coal Co. employed the late John S. Boyden. The link between Boyden and Peabody has been thoroughly researched by the Indian Law Resource Center, which first reported the Martindale-Hubbell entry, and confirmed in independent studies.

We apologize for the error in the caption.—Ed.

UTOPIAN GENETICS

The October 1986 issue presents sharply contrasting views of genetic engineering. *Continued on page 8*

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LETTERS

CONTINUED

In "Setting the Record Straight on Biotechnology" (page 38), David Baltimore assures the reader that the Food and Drug Administration regulates human growth hormone to prevent its use by parents who desire offspring with superior traits. But then in a review of K. Eric Drexler's *Engines of Creation* ("Machines from Molecules," page 76), Hans Moravec seems to endorse the very genetic alterations that would alarm cautious scientists like David Baltimore.

Before this technology accelerates to escape velocity, everyone should ponder this question: What are we escaping to? Is it really the utopia envisioned by Moravec? Indira Gandhi, the late prime minister of India, noted that technological advances have not been accompanied by studies of how they might affect people—or how (and by whom) they might be used. She also observed that modern science has increased the disparities existing within and between nations.

In an elitist society that glorifies athletic prowess and scholastic ability, technology is exploited by the wealthy. It is fine for a single individual to dream of being stronger and wiser. Contemplating what would be best for humanity as a whole is another matter entirely.

WILLIAM J. STREMMEL
Seattle, Wash.

THE COST OF WATER

In "Water: Not as Cheap as You Think" (November/December 1986, page 30), Peter Rogers has ignored how much the cost of energy contributes to the real cost of water. Perhaps alternatives such as solar power could help when water recovery requires energy-intensive methods.

DANIEL B. HAWKINS
Fairbanks, Alaska

Peter Rogers should be advised that when oceans or rivers are diverted for cooling power-plant condensers, the only effect on the water is a slight increase in temperature—typically about 2° F in U.S. practice. Water quality is not affected in any way.

In general, cooling towers cause water losses of a few percent through evaporation, and they are more expensive to build and operate than are systems for cooling by diverting surface water.

JEROME S. GOLDHAMMER
Tyngsboro, Mass.



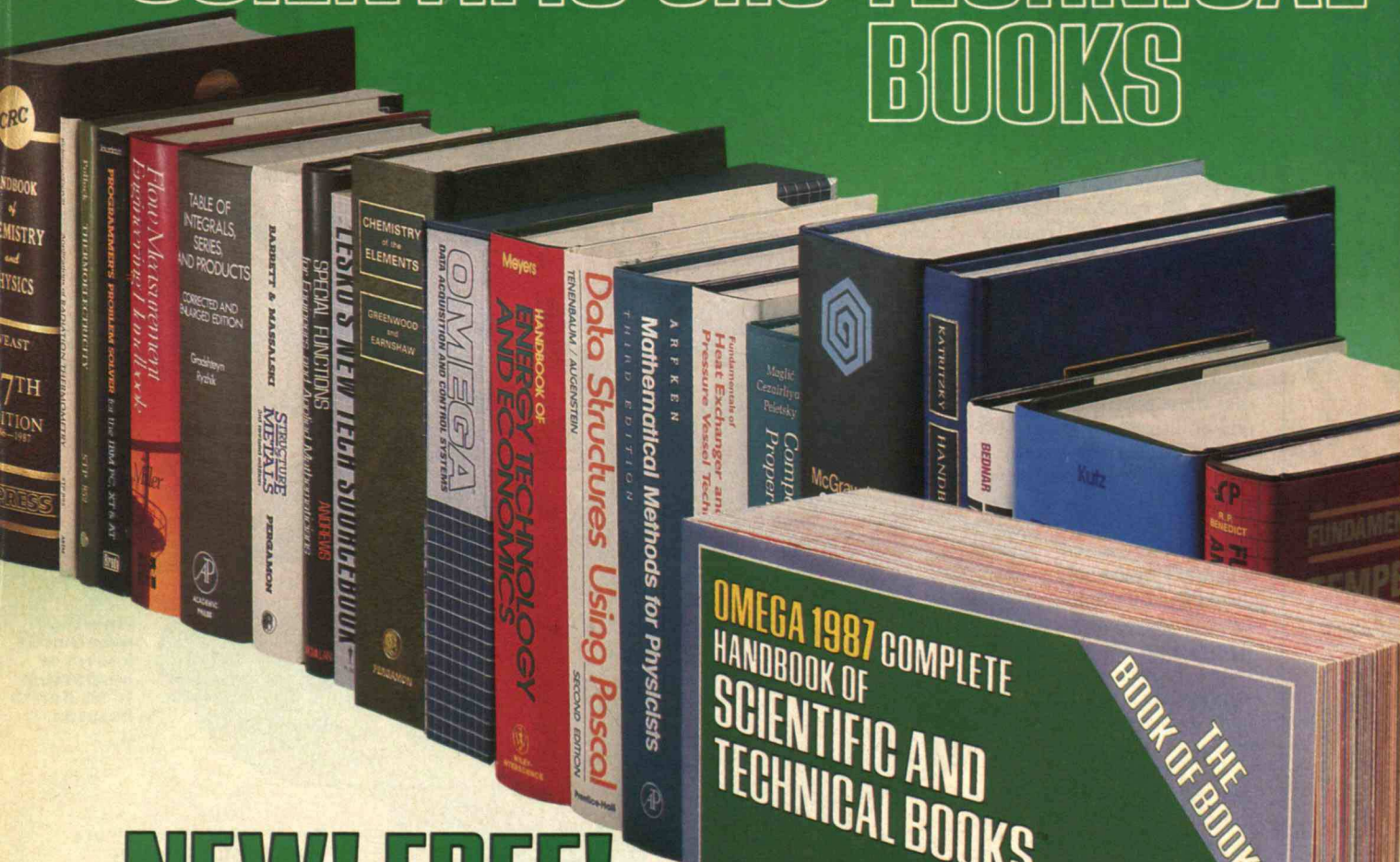
THE USES OF DICTATORSHIPS

Lester Thurow's "Who Said Military Dictatorships Are Good for the Economy?" (November/December 1986, page 22) ignores one fundamental cause of poverty in developing nations, and indeed the raison d'être for many military dictatorships: foreign investment. While dictatorships do gorge themselves at the expense of the great majority of the populace, they are almost without exception acting mainly in the interests of U.S. business and the CIA. The history of repressive regimes in the Philippines, Indonesia, Iran, Guatemala, El Salvador, Chile, Paraguay, Argentina, and Brazil proves as much.

In most of these cases, a CIA-aided dictator or junta overthrew the existing government soon after legislation harming the interests of U.S. or allied corporations was introduced. A look at the post-coup economic situation is usually revealing. A 1968 Brazilian Commission of Inquiry study showed that 11 major multinationals operating in the country had a return-on-investment ratio of 5 to 1: while they had brought in only \$298.8 million, they managed to reinvest \$693 million and remit \$744.5 million abroad. By the 1970s, foreign capital controlled some 50 percent of manufacturing sales and 59 of the 100 largest manufacturing companies. In the absence of a dictatorship, such thinly disguised pillage would have caused a popular revolt.

ERIK MAR
Cambridge, Mass.

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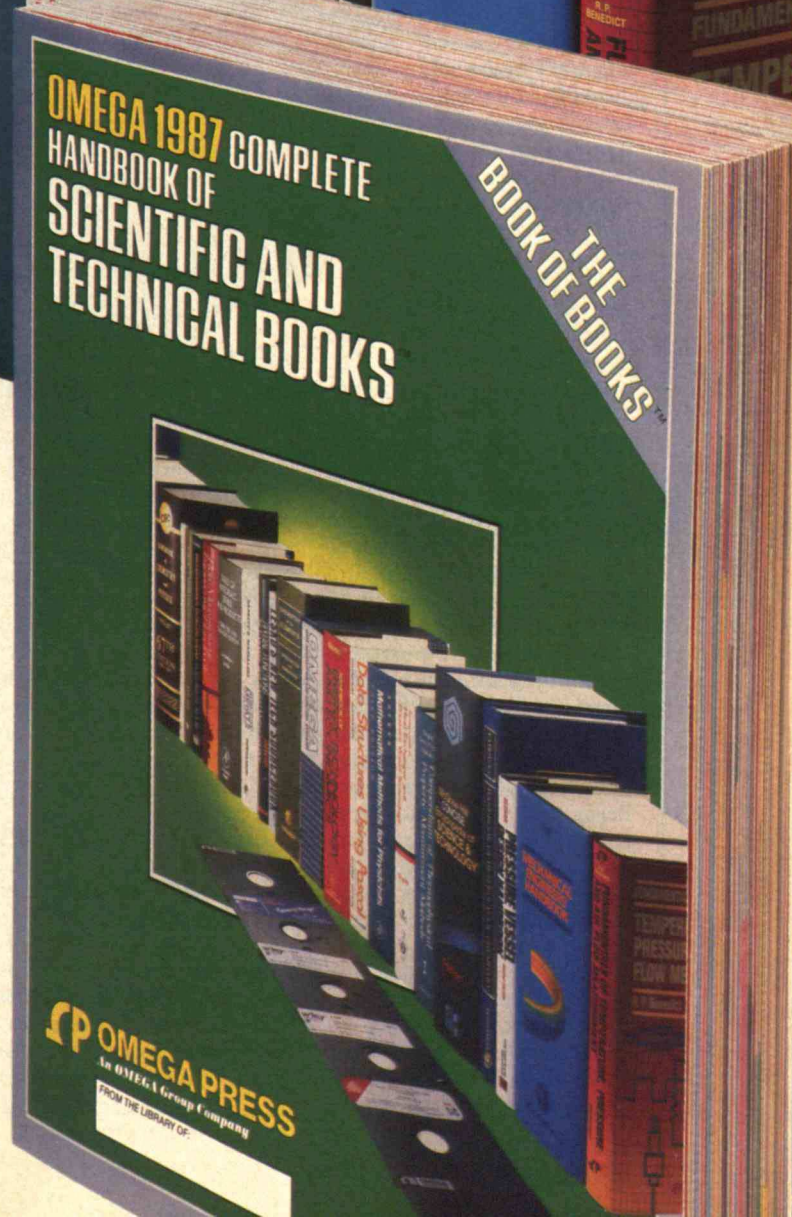
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Bug-Spray Alert

Pick up a can of bug spray and read the label carefully. The product may be composed almost entirely of so-called inerts. For example, 97 to 99 percent of Raid is "inert substances." Public-health officials warn that these potentially hazardous additives are largely unregulated and untested. In many cases, they aren't even specified on the label.

Inerts dissolve, propel, or otherwise enhance the active ingredients in household and agricultural pesticides. Some inerts are also found in other consumer products, including paint remover, spray shoe-polish, and hair spray.

The Environmental Protection Agency (EPA) estimates that at least 1,200 inerts are used in 50,000 pesticides. The agency indicates that about 100 inerts are known or suspected health hazards. The substances are associated with cancer, serious rashes, and damage to the central nervous system. Data are lacking for 800 inerts, and EPA has cleared only about 300 as safe for use.

Several recent pesticide poisonings underscore the problem. In June 1985, Michael Landon, a 29-year-old pest-control worker, crawled under a house trailer in San Bernardino, Calif., to spray for bugs. His spray gun leaked, asphyxiating him and sickening three others who tried to help him. A California Department of Health Services physician ruled that he died from methylene chloride, not from the active ingredients in his spray gun. Methylene chloride, a carcin-

ogen, is commonly added to bug spray as a solvent.

In May 1986, 128 orange pickers in southern California suffered severe burns and rashes after Uniroyal Chemical Co. added a new inert, poly vinyl acetate, to the pesticide Omite-CR. Uniroyal withdrew the product from the market and plans to reintroduce it with stronger restrictions on its use.

Each year a thousand pesticide poisonings are reported to the Delaware Valley Poison Control Center in Philadelphia. Of these, "at least 50 percent are due to inerts," estimates executive director Tom Kearney. Corrine Ray, administrator of the Los Angeles Poison Information

Center, links inert ingredients with nine of ten symptoms of household-pesticide poisonings that have been reported to her organization.

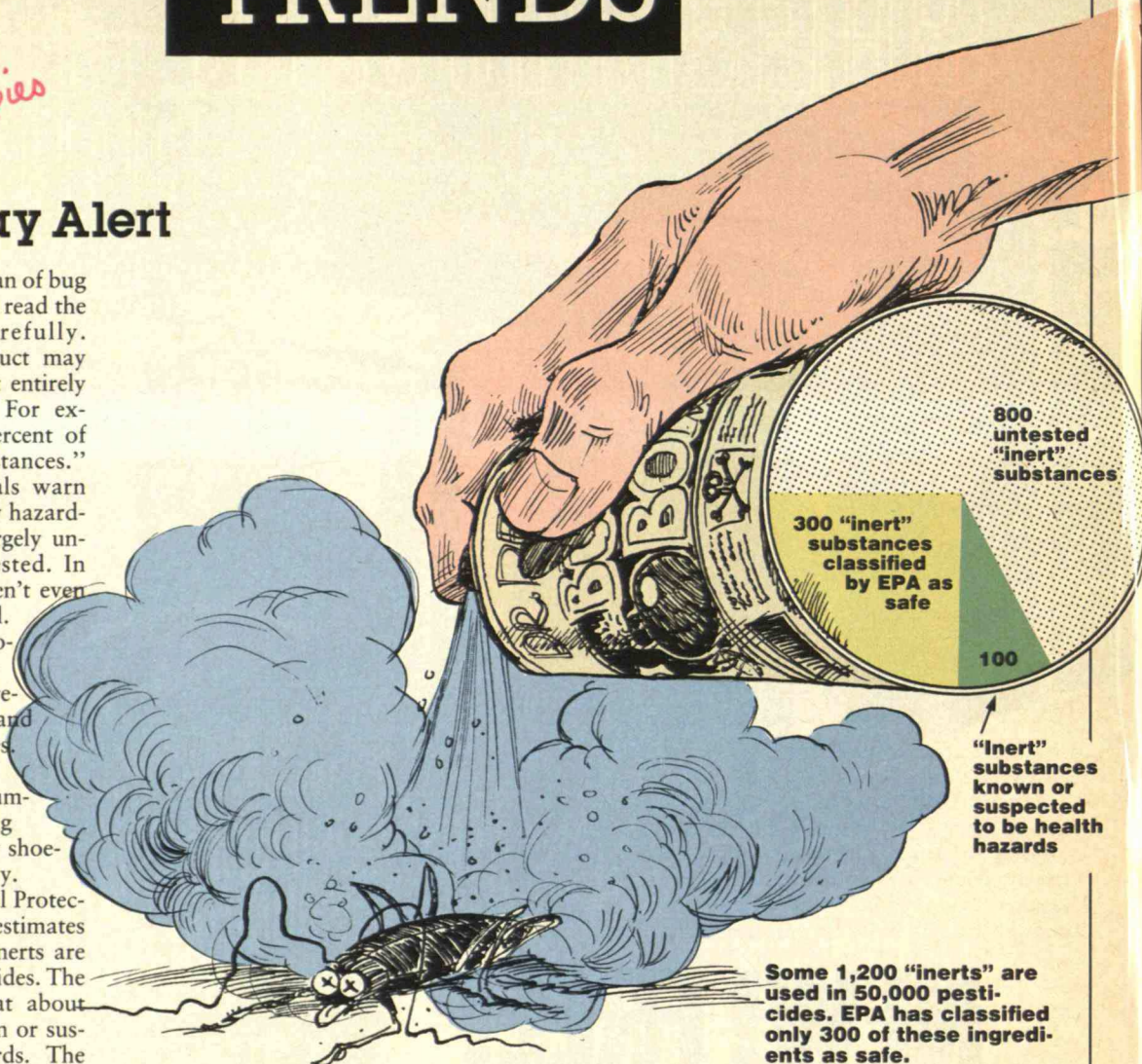
Industry officials say the dangers are exaggerated. "A significant number of the chemicals are no longer being used," says Ralph Engel, president of the Chemical Specialties Manufacturers Association. Many others in the business add that secrecy about inerts is not a problem, either. "Our labels are in compliance with the law, and often go beyond the law," notes Pauline Grieger, public-relations manager for Johnson Wax, which manufactures Raid.

In explaining why the

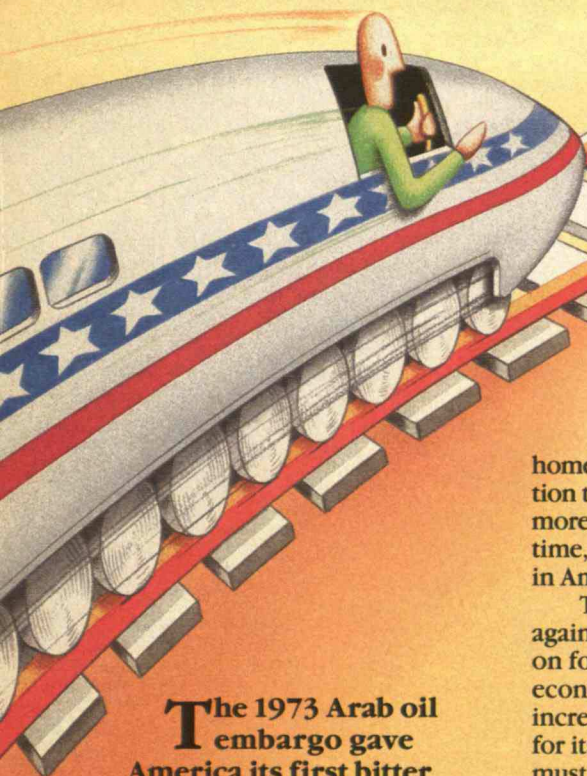
identities of some inerts remain secret, company officials say they don't want competitors to know what is in their products. However, this secrecy inhibits regulation and can be dangerous. Data that would help in treating patients is sometimes not readily available to doctors.

Company representatives say they do give out information during medical emergencies. "If someone is sick, we will give the information to the doctor," says Desmond Byrne. He is manager of registration and regulation at Chevron Chemical Co.'s Ortho Agricultural Chemicals Division.

But many industry leaders agree that to call a chemical



Nuclear electricity gives America the power to make critical economic decisions.



The 1973 Arab oil embargo gave America its first bitter taste of foreign oil dependence. To protect our economy, we turned to electricity. Using American resources and technology. As a result, nuclear energy has established itself as a cornerstone in rebuilding a strong economy.

The electrification of America

Electricity is the only major form of energy that has experienced overall growth since 1973. We are using 36% more now than we did then. It serves new uses in our factories and heats twice as many of our

homes. Nuclear energy's contribution to our electricity supply has more than quadrupled during that time, helping fuel a 34% growth in America's economy.

There are still no guarantees against becoming too dependent on foreign oil once again. Our economy continues to require increasing amounts of electricity for its growth. And that electricity must continue to come from nuclear energy, as well as coal and other domestic sources.

The growth of nuclear energy

American nuclear electricity was born in 1956. By 1973, it had become a technology America could turn to when faced with the oil crisis. And today, over 100 nuclear plants make nuclear energy our second leading electricity source, behind coal. In fact, nuclear energy and coal together have provided over 95% of all new electricity generated in America over the past decade.

Nuclear energy also saved Americans between 35 and 62 billion dollars from 1974 to 1985,

compared to the cost of non-nuclear-generated electricity. It has displaced over two billion barrels of oil. And its contribution continues to climb. The U.S. Department of Energy estimates that nuclear energy will provide 20% of our electricity by the early 1990s.

Nuclear energy for a secure future.

Nuclear energy has proven its worth to America's economy. Auburn University Dean of Engineering Dr. Lynn Weaver recently described nuclear energy as "...one of the basic props supporting the entire national economy."

Yet, in spite of all we've accomplished, the threat of foreign oil dependence remains. Difficult choices will still need to be made. But one fact has made itself very clear: the more we develop our own energy sources like nuclear energy and coal, the more we control our own economic destiny.

For a free booklet on energy independence, write to the U.S. Committee for Energy Awareness, P.O. Box 1537 (ED31), Ridgely, MD 21681. Please allow 4-6 weeks for delivery.

Information about energy America can count on

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inert is misleading. "I wish the name inert were never used," says John McCarthy, director of scientific affairs for the National Agricultural Chemicals Association. "We're not saying that they don't have some biological properties."

Regulating Inerts

The Consumer Products Safety Commission (CPSC), which regulates consumer chemicals, may declare all consumer products containing methylene chloride to be hazardous. CPSC recently reported that "it is likely a significant number of consumers are being exposed to high concentrations of methylene chloride," some at levels "known to cause cancer in animals."

CPSC and EPA have been working together to find out what other chemicals consumer products contain. And EPA is trying to formulate a policy for regulating inerts in commercial pesticides. In June 1985, the agency listed 55 inert ingredients of "toxicological concern." A second list issued in the spring of 1986 revealed another 51 inerts with chemical structures "suggestive of toxicological concern."

EPA has recommended that manufacturers stop using such compounds and "look for less toxic ingredients," says Tina Levin, a toxicologist from the agency's Office of Pesticide Programs. EPA officials say that pesticide manufacturers are seeking substitutes, but still use some dangerous inerts extensively without warning labels. □

WILLIAM KISTNER and ANDREW PORTERFIELD write for the Natural Resources Project of the Center for Investigative Reporting in San Francisco.

Mars Colony Grows in Arizona

White surveyors' flags dot the Arizona desert hillside where in three years a miniature ocean will teem with 15,000 types of sea creatures. On cliffs above, water will flow from a tropical rainforest through savanna marshlands to replenish the sea. Beyond the savanna, a desert will thrive. In all, seven biomes—small regional ecological systems—will make up Biosphere II, technology's first attempt to recreate the world in some semblance of its enormous variety. Biosphere I, say the designers of this artificial world, is Earth itself.

Other groups, including NASA, have built up viable systems one component at a time. Biosphere II will be the first to begin with all its complexity intact. The project could help us understand our own planet enough to establish conditions that would allow life, from microbes to humans, to thrive elsewhere.

Those working with Biosphere II see Earth's resources and habitable land as limited, its atmosphere tainted, its population exploding. The researchers consider their work a step to off-Earth colonies—in orbit, on the Moon, or on Mars. As would be the case in a space colony, everything in the system will be recycled. Only energy and information will be supplied from outside.

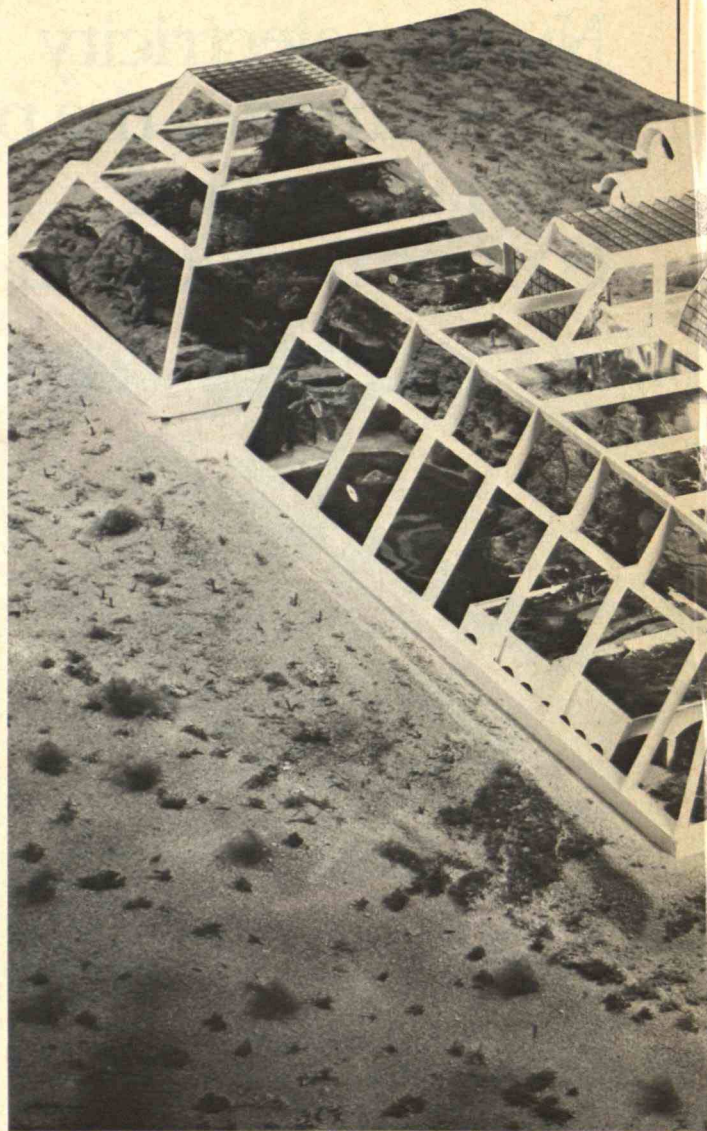
Biosphere II sits on a two-acre virgin tract across the mountains from Tucson. Over 2,500 acres around the site will be a buffer from the rest of the world. Green-

houses for testing crops, tissue-culture facilities for making disease-resistant plants, and administration buildings have already been erected on the property. Ground breaking for the biosphere itself was in January.

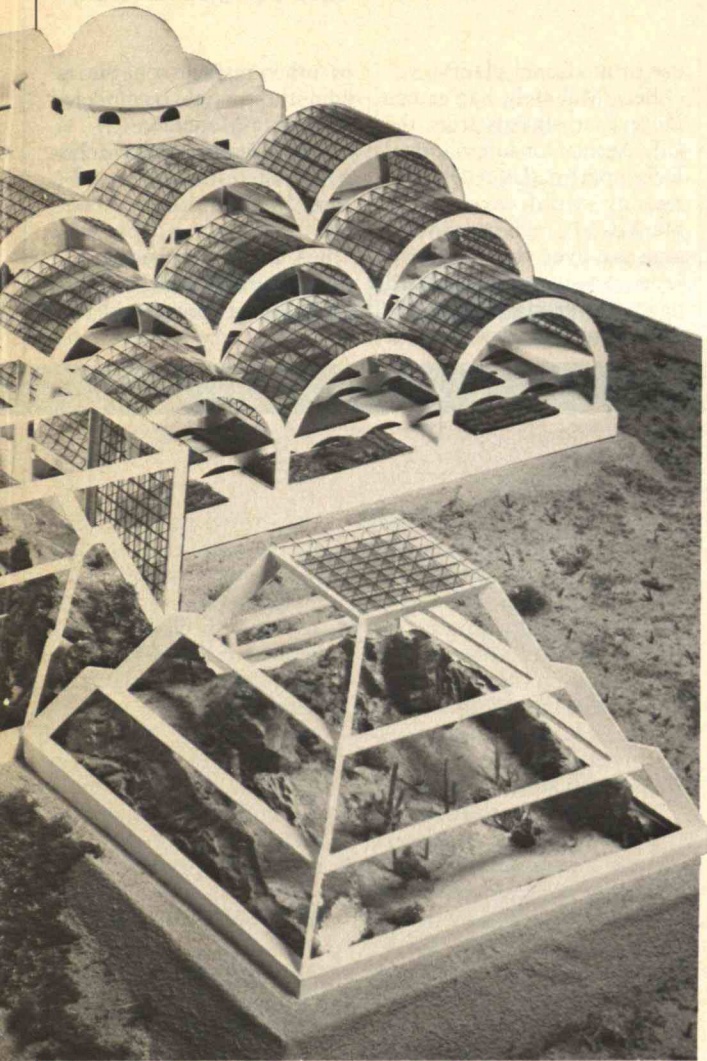
The first two years of the project, which began in 1984, focused on design and engineering. Biosphere II should be partially isolated from the outside world by mid-1988, and full closure is planned for mid-1989. At that time, eight people—the "biospherians"—will be locked inside for a two-year stay.

No food, water, medicines, building materials, books, newspapers, people, or waste will pass into or out of the biosphere, but information exchanges will be steady. Telephone contact will be continuous. Video cameras and computerized monitors will let scientists outside sample atmospheric and oceanic conditions, take a minute look at diseased organisms, and note any changes within the system. The biospherians will have computers to gather information they need for their research.

Special computerized lou-



Biosphere II, under construction in Arizona, is an attempt to duplicate Earth's varied geography and life forms.



vers will control how much sunlight comes in. Temperature maintenance, water circulation between ocean and rainforest, the growth of sea creatures, and the intensive agriculture needed to supply food will all depend on the ability of these louvers to perform well.

A crucial decision is exactly which plants and animals to include. The innovative Environmental Research Laboratory (ERL), a semi-autonomous adjunct to the University of Arizona, has contributed several new intensive-agriculture methods.

Among these is tilapia, an ugly but tasty fish that can be grown in tanks of fresh or salt water. Tilapia can flourish on a steady diet of vegetable matter, and they produce a large amount of food compared to the amount they consume. Carl Hodges, the head of ERL and a project manager of Biosphere II, believes the fish could become "the chicken of the aquaculture industry." More familiar animals will also be in the biosphere, including small goats, chickens, and rabbits.

Space Biosphere Ventures (SBV), a consortium of inves-

tors, is funding Biosphere II. SBV's head, Texas oil magnate Edward P. Bass, has committed \$30 million over a seven-year period. Private funding of this magnitude is contingent on the possibility of significant returns. SBV expects to "produce and market biospheres and biospheric systems by 1992," according to a company brochure. The pay-off may come in contracts from NASA, the European Space Agency, and other space organizations.

SBV, a for-profit corporation, foresees down-to-earth applications as well. As a "test tube," Biosphere II could be used to find out more about Earth's changing environment, especially in unmanned experiments after the biospherians' two-year sojourn is over. For example, to learn about the effects of the increasing level of carbon dioxide in the atmosphere, carbon dioxide could be allowed to build up in Biosphere II. And Kathleen Dyhr, SBV's director of information systems and a prospective biospherian, suggests testing pesticide toxicity levels and effects in Biosphere II, where they wouldn't risk contaminating the whole world.

Decisions on a multitude of details have yet to be made. The inventory of plants, animals, and other living creatures and the mix of atmospheric components and other factors will inevitably be adjusted before the final sealing. Even afterward, materials or people could pass through an airlock. However, such exchanges will be kept to a minimum since they would break Biosphere II's isolation and detract from the significance of test results. □

RUTH A. LEWIS is a science teacher and free-lance science writer in Tucson, Ariz.

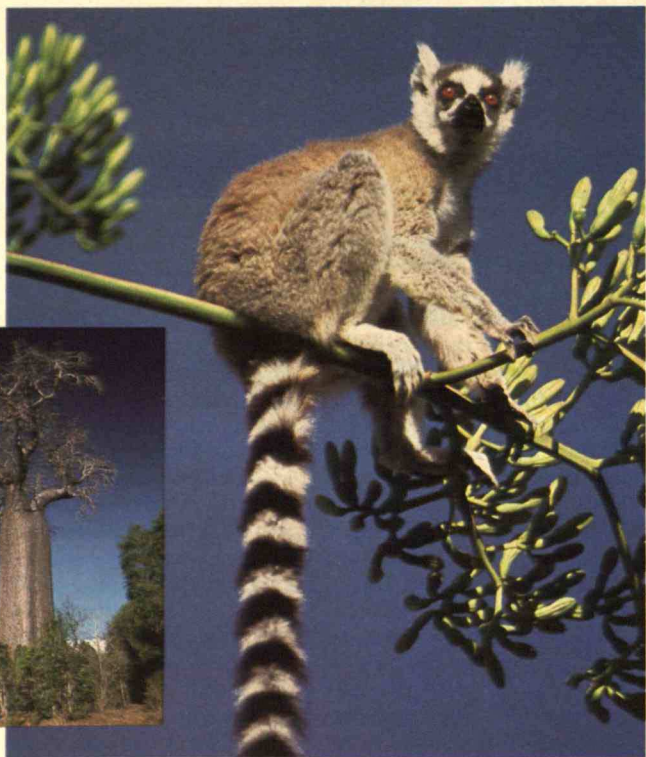
Saving Paradise

Two hundred fifty miles off the East African coast lies a primeval paradise under siege—Madagascar, the world's fourth largest island. It has emerged as a focal point in the struggle to save the world's dwindling tropical forests and biological diversity. A unique conservation project there could make the island a model for U.S. development aid to other parts of the tropics.

"Darwin made the Galapagos Islands famous because of the isolated species he found there, but there's no comparison to what we're finding," says Robert W. Sussman, a Washington University anthropologist who has spent five of the last fifteen years on Madagascar. The island supports 200,000 different kinds of plants, animals, insects, and microorganisms—5 percent of the earth's total. Three-fourths of them may not be found anywhere else.

"An evolutionary accident transformed the entire island into a living laboratory," says Alison Richard, chair of Yale University's anthropology department. Eons ago, Madagascar broke free from Africa and gradually drifted eastward. For at least 60 million years the island has been a world unto itself.

Without competition from advanced species, primitive forms of life that became extinct elsewhere flourished on Madagascar. The number of species has diminished dramatically since Indonesians first colonized the island 1,500 years ago. But many primitive species still survive, offering a unique opportunity



The lemur and the baobab tree are two of 150,000 species unique to Madagascar. The island is a lab for a way to save biological diversity.

use of medicinal plants.

Beza-Mahafaly has caught the eye of officials from the U.S. Agency for International Development (US-AID). The agency could earmark as much as \$10 million for Madagascar over the next two years. Sussman and Richard have also proposed that US-AID support the development

of other reserves on the island; these would be modeled after Beza-Mahafaly.

The scientists believe US-AID's interest could signal a shift in U.S. policy. "Too often," Sussman observes, "the United States has tried to solve Third World problems by pumping foreign aid into a country without any

MINI TRENDS

EARTHQUAKES AND ENERGY

A major earthquake is almost certain to occur in the eastern United States within the next 25 years. According to a report by the American Association of Engineering Societies, the event could disrupt electrical, pipeline, river, and railroad distribution systems, leaving thousands of consumers without energy.

"Our purpose in conducting the study was not to present a doomsday situation, but to raise public awareness of the danger and encourage research, planning, and construction needed to reduce potential hardships" says the paper's principal author, James E. Beavers. He believes the threat is greatest in the Mississippi Valley. The larg-

est known earthquakes in North America occurred there in the early 1800s, when the population was small.

Today, the valley is densely populated and dependent on extensive interlocking energy grids. The report notes that "the electrical energy generating and distribution system is the most vulnerable to damage from earthquake forces because of its more complex and fragile construction."

WATCHING YOU

Soon there may be no place left to hide. The U.S. Navy has recently come up with radar technology that can detect the breathing or heartbeat of a friend or foe from as far as 300 feet away. When used at much closer range, one version of the technology detects people behind brick or concrete walls.

The navy says its main interest lies in helping medical personnel determine who's alive on a dangerous battlefield. Kun-Mu Chen, Michigan State University electrical engineering professor, thinks such systems will also be used to locate people trapped in buildings after earthquakes or explosions. He reports that in tests on radar he developed, a human being behind a brick barrier "was holding his breath, not moving at all, and



to learn about evolution. For example, Sussman and Richard are examining Madagascar's lemurs, the oldest living relatives of human beings.

Because of close ties to Madagascar scientists, the two Americans were among a handful of Westerners allowed to continue studies there after a socialist military coup in 1973. Both have become alarmed at the deteriorating ecological situation. Less than 10 percent of the island's natural vegetation remains. "All of the plants and animals unique to Madagascar are threatened, endangered, or have already vanished," Sussman reports. Madagascar's profoundly poor and rapidly expanding population is devouring the natural vegetation at an alarming rate.

In 1979, two years before the U.S. embassy in the capital reopened, Sussman and Richard spearheaded an emergency conservation effort. Having received a five-year grant from the World Wildlife Fund, they worked with their Madagascar colleagues to establish Beza-Ma-

hafaly, an independent reserve of about 1,500 acres in the southwestern part of the island.

The result has been an extremely effective form of scientific diplomacy. Washington University, Yale University, and the University of Madagascar all agreed to cooperate on the project, and Mahafaly villagers donated the land for the reserve.

Last year, the Madagascar government showed its enthusiasm by making Beza-Mahafaly a special national reserve. And the project's success may have paved the way for an increasingly productive alliance with the West.

An International Precedent

As many as a dozen U.S. scientists with different specialties will utilize the reserve in 1987. "Relationships between disciplines help us get the whole picture—the people and the environment—to find ways to use the resources in a sustainable way," Sussman notes. The researchers will look at everything from agricultural techniques to the

thought to cultural differences" between countries. He is encouraged by US-AID's acknowledgment that he and his associates "are getting the kind of ground-level data required to make effective policy choices."

For Sussman and Richard, Beza-Mahafaly represents the assurance that their own

work with lemurs will continue. But more significantly, a new generation of diplomat-scientists is confronting the rapid destruction of tropical forests and the possible extinction of as many as 750,000 species worldwide. "Madagascar is a microcosm of what's happening throughout the tropics," says Suss-

man. "If we are unable to save Madagascar, it will be a bad omen for the rest of the tropics and, consequently, for the earth." □

ROBERT G. BROCK is a Denver-based free-lance writer who focuses on the environment and other issues in science and technology.

Raccoons and Rabies

Scientists are trying to control rabies in wild animals by redesigning the virus that conquered smallpox. As long as rabies is common in wildlife, it can spread to humans. Even with widespread vaccination of domestic dogs and cats, up to 30,000 people are treated annually in the United States for possible rabies infection. Pets infected by animals such as raccoons, skunks, and foxes are a main avenue for infection of humans.

Fortunately, documented cases of human rabies have almost disappeared. According to Daniel B. Fishbein at the U.S. Centers for Disease Control, an average of only 1.5 human cases are reported each year—and none in the past two years. "It's a very rare disease," Fishbein says, "because the dog vector has been eliminated."

Nevertheless, worries persist because rabies is spreading among raccoons in the mid-Atlantic states. In 1984, raccoons accounted for 83 percent of the animal rabies cases reported in that region, even though the number of cases was down 25 percent. In Virginia, the disease is moving south "toward the urban centers of Richmond and the tidewater areas," says Brian Perry, an epidemiologist with the College of Veterinary Medicine at Virginia Polytechnic Institute.

In response, scientists at the Wistar Institute in Philadelphia are using powerful new biotechnology tools to customize the vaccinia, or cowpox, virus that was used to eradicate smallpox. Charles

we could pick up the heartbeat." Chen's system can detect a heartbeat 200 feet away across an open field.

Joseph Seals at Georgia Tech is responsible for the system that can achieve the same thing at 300 feet, but he warns that it may not work well on a chaotic battlefield. He finds that even waving blades of grass can add substantial "noise" to the signal.—Robert Cooke

CHEMISTRY IS WHAT?

While more than 80 percent of adult Americans say they support chemistry and chemists, the vast majority haven't the slightest idea what the science does. The American Chemical Society came to this conclusion on the basis of public-opinion data that Cambridge Reports, Inc., gathered last fall.

Those polled were asked: "Chemists work with the fundamental building blocks of all materials. When you think of these fundamental building blocks, what one thing do you think of?" Three out of four answers showed that respondents lacked even a rudimentary knowledge of the 90 or so chemical elements in nature.

The survey also found that 83.8 percent of the public be-

lieves chemistry has produced more desirable than undesirable results. But people don't think so highly of the chemical industry. Just over half the public—51 percent—views industry unfavorably, up from 41 percent in a 1980 survey.

BIODEGRADABLE PLASTIC

Starch from surplus corn may be the key ingredient in the first biodegradable plastic mulch. Mulches spread on a field protect tomatoes and other high-value crops from weeds and drought. They also extend the growing season by warming the soil in the spring, so that farmers can produce an earlier crop at a good price.

The mulches in use now are made from petroleum-based chemicals. The biodegradable alternative would cost a little more, but it would save disposal expenses of about \$100 an acre.

SHELL HISTORY

Like rings in trees, thin-as-a-hair bands in quahog shells are thought to indicate age and growth rates. The more lines, the older the shell. And the bigger the space between lines, the faster the growth. But quahog shells may indicate more than age. Accord-



ing to *Marine Resources Information*, this space may tell the story of bay temperatures and salinity. Scientists at the University of Rhode Island and the University of Florida say the shells can help paint a picture of the conditions that existed in Narragansett Bay thousands of years ago.

Ground quahog shells have been treated with acid, which breaks them down into basic components called stable isotopes. Measurements of the oxygen and carbon isotopes are compared to temperature and salinity charts. These results are compared to water-quality data to help form a model that could shed some light on what affects quahog growth. Once the connection between shell growth and the chemistry of present-day seawater is understood, scientists could use the knowledge to analyze fossil shells.

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R. Rupprecht, a Wistar team leader, says his group has modified vaccinia virus by inserting a gene taken from a naturally occurring rabies virus. This gene, when inserted into vaccinia virus, makes animals produce antibodies that protect against rabies virus. The tailored vaccinia virus cannot cause rabies, but does stimulate a strong immune response against the disease. "From these studies, it is clear that most raccoons immunized with the virus will be protected from rabies street-virus infections," Rupprecht and his colleague wrote in the *Proceedings of the National Academy of Sciences*.

The Testing Question

The altered vaccinia virus has not yet been tested in animals in the wild, and when it will be is still an open question. The Wistar rabies work became highly controversial after the team sent samples to Azul, Argentina, for vaccinating cows. The scientists were accused of trying to conduct field tests on their virus without going through U.S. regulatory procedures.

The research was part of a Pan American Health Organization (PAHO) program to save an estimated 1 million cows lost to rabies every year in Latin America. The tests, which began last June, were halted three months later. PAHO was severely criticized for not notifying the Argentine government of the genetic-engineering experiment.

Soon after the halt, 134 Argentine scientists wrote to *Nature*, complaining that the cows' caretakers had not been vaccinated against smallpox and were not under proper medical surveillance. The Argentine scientists also charged that the caretakers and their

families drank unpasteurized milk from vaccinated cows, and that the immunized cattle were not totally isolated from other animals. Worse, they added, "We feel that our country has been illegally used as a test field for a kind of experiment that is not yet accepted in countries where basic research on this vaccine had originated."

Wistar officials replied that the workers had indeed been immunized, that they were being monitored for signs of infection, and that no laws had been broken. The U.S. National Institutes of Health, which oversees all genetic-engineering work funded by the U.S. government, declared that Wistar had not violated any U.S. regulations, since the

Argentine work had received no federal money.

Despite the absence of permission to field test the new vaccine, experiments are continuing to see if raccoons will indeed take the bait—but without vaccine. The idea of vaccinating wild animals is not new, but there is no effective, economical way to trap and immunize large numbers of animals. When faced with disease outbreaks, authorities usually exterminate animals rather than vaccinate them.

According to Suzanne Jenkins, a Virginia Department of Health epidemiologist, an anti-rabies vaccine for wildlife "has to go hand-in-hand with research on the development of an effective baiting

system." Instead of capturing animals, European researchers have laced tasty bait with an anti-rabies vaccine. Foxes were immunized with some success, but the weakened live virus used in those tests is essentially ineffective in raccoons and skunks.

Similarly, Wistar researchers in airplanes have dropped baits laced with tetracycline, a broad-purpose antibiotic, into wooded areas of Pennsylvania. Raccoons captured later showed clear signs of having ingested the tetracycline. The next step could be to lace bait with the vaccine, but when or where this will occur is unknown. □

ROBERT COOKE is a science writer for *Newsday* in New York.



At a January conference, banker Felix Rohatyn (right) and executive Alan Sagner discussed SDI's impact on business.

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Business versus Star Wars

In January, 350 executives heard investment banker Felix G. Rohatyn warn that the Strategic Defense Initiative (SDI) places "a heavy burden on American business." He told them that SDI's "impact will ripple through America's economy and shape its national priorities well into the next century."

Rohatyn's audience came from the real-estate, banking, advertising, manufacturing, and oil industries, as well as from union management, university administration, and the French and Italian governments. They had gathered in New York to discuss "SDI and Its Impact on Business" at a conference sponsored by Business Executives for National Security (BENS).

Stanley A. Weiss, chair of American Minerals, Inc., founded BENS in 1982 and is currently its president. He says the organization takes "a businesslike approach to weapons systems." Executives use it to advocate what they believe is more effective and responsible management of defense spending. The organizers of BENS are motivated by deep doubts about U.S. defense policy—especially SDI—and seek to reduce nuclear risks.

At a 1984 symposium for defense contractors, an executive had asked Lt. Gen. James A. Abrahamson, director of the Strategic Defense Initiative Organization, a long question about SDI's feasibility. Abrahamson had simply replied, "The answer is yes." Three years later, that view was repeated at the BENS conference by SDI supporters such as Rep. Jim

Courter (R-N.J.), a member of the House Armed Services Committee; Gerold Yonas, formerly Abrahamson's chief scientist; and Michael Mobbs, assistant director of strategic programs for the Arms Control and Disarmament Agency. They maintained that part of SDI would be deployed on schedule—by the early 1990s. Mobbs and Courter compared skepticism about SDI to initial reactions to nuclear power, electric currents, and radar.

Former CIA director William E. Colby countered, "I'm not skeptical of SDI; I'm against it. It won't work. It's dangerous. It's a waste of money." Now a political consultant whose clients include the Japanese government, Colby lauded that country's emphasis on commercially useful research.

SDI is draining talent and money that could further civilian innovation and productivity, said Richard L. Garwin, a physicist who worked on the hydrogen bomb and is now a fellow at IBM's Watson Research Center. He observed that "while the United States was concentrating on the Apollo program, the Japanese were studying consumer and industrial technology and manufacturing, and that is when they began to eat our lunch."

Pointing to the value of commercial spin-offs from SDI research, Charles S. Bridge, Litton Industries' chief scientist, predicted "advancements in communications, transportation, energy generation and utilization, optics and image processing, new high-strength, lightweight materials and structures, and data-handling and



processing—to name just a few."

But John Shore, formerly of the Naval Research Laboratory, responded that "justifying SDI by spin-offs is like justifying professional football by looking at astroturf." He believes that military research and development is too specialized for most technical people to make a transition to civilian work. Colby said the United States should target research directly on spin-offs instead of expecting indirect benefits from SDI.

After the conference, participant Jonathan Conrad of the Sconset Group, a merchant banking company, said BENS had not changed his mind about the economic opportunities that SDI and defense-related high-technology transactions offer. Conrad is convinced that "SDI represents a tremendous opportunity. Military-directed technology has always stimulated commercial technology. Look at radar, the chronometer, penicillin, jet power, integrated circuits."

However, Peter A. Michel, president of the Penn Central Technical Security Co., was swayed. Michel, a liberal Republican, is considering running for Congress from southern Connecticut. He came to the conference "enthusiastic about the concept

of SDI," but the rhetoric of its advocates discouraged him. "Either the government made a very bad case, or the government case is very weak," he said. Michel thinks that SDI puts defense contractors in a bind: "It's a necessary involvement, but not an economically attractive one."

Lehman Management Co. aerospace analyst David A. Lange concluded that the matter is academic. "The SDI debate has been decided," he remarked. Over 3,000 Pentagon contracts are already in place, for \$6.7 billion worth of space-defense research.

Nevertheless, Alan Sagner, chair of the BENS metropolitan New York chapter, believes that the verdict is not entirely in. "There are still many important decisions to be made about SDI," he says, adding that the conference "put a pin in the butt of people who weren't aware that SDI is not a simple issue." He feels that business people have a great deal of influence on Congress and therefore need to hear "different viewpoints on the definition and costs of SDI." □

ANN MARIE CUNNINGHAM is a free-lance writer specializing in defense issues. She is co-author of *Future Fire: Weapons for the Apocalypse* (Warner, 1983).

The Three Mile Island cleanup is yielding data about how chemicals behave during a severe nuclear accident.

Chemical Chaos in a Runaway Reactor

The "bubble" of hydrogen that collected in the reactor containment vessel at Three Mile Island (TMI) showed the public what extraordinary chemical events can occur during nuclear reactor accidents. Experts were also surprised by another aspect of TMI: despite the magnitude of the accident, little volatile radioactive material was produced, and almost none escaped into the environment.

These and other TMI surprises provoked study—previously neglected in the United States—of a new branch of nuclear chemistry devoted to the chemical chaos that occurs in a severe accident such as TMI or Chernobyl. This work is beginning to bear fruit; indeed, it has reached a "major milestone," said Dana Powers of Sandia National Laboratories during a four-day American Chemical Society symposium late last fall. According to Powers, severe-accident chemistry provides a framework for understanding the flood of chemical data that is coming from many U.S. laboratories. It's possible to predict how some important radioactive materials will behave during various accident scenarios.

Among the findings:

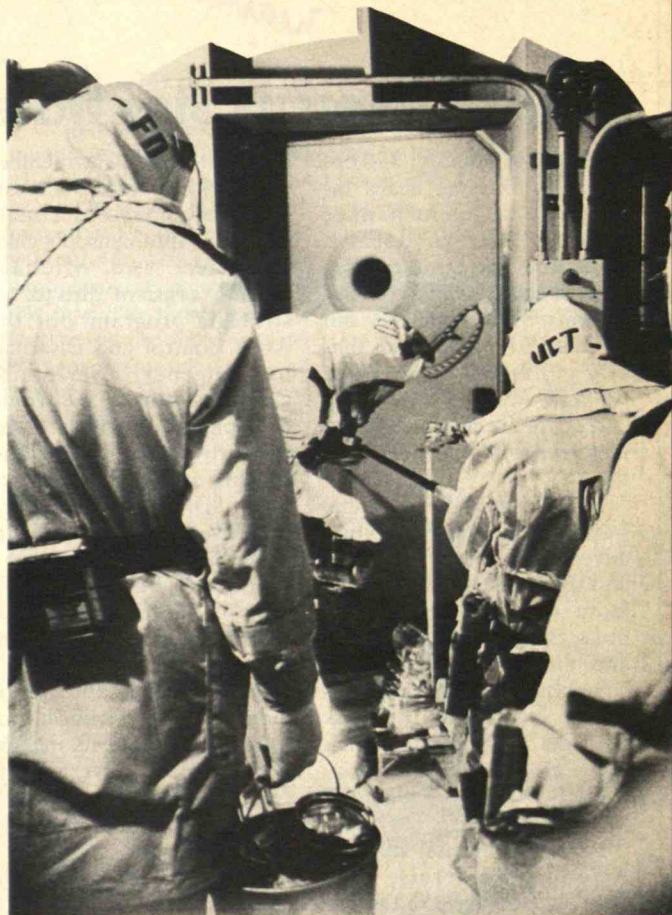
□ When nuclear fuel rods melt, zirconium in their containers combines with steam to produce hydrogen—the TMI "bubble"—and vast quantities of heat. Heat from this chemical reaction may be more important in determining the course of an accident than heat from the radioactive decay, said Susan J. Niemczyk of Gull Associates,

Washington, D.C.

□ The chemistry is dynamic and complex—a fact becoming clear as demolition of the damaged TMI reactor proceeds and details of the accident are revealed. For example, temperatures within the TMI containment vessel varied widely from place to place. Thus, many radioactive forms of cesium and iodine stayed in the debris instead of boiling into the air because parts of the structure remained too cool, explains Richard R. Hobbins of EG&G Idaho, Inc.

□ Should a reactor structure fail completely, the chemistry would become very different from that at TMI. If the mass of molten fuel and structural materials reaches the floor of the containment vessel, the concrete may be converted into a radioactive vapor that does not recondense. But the intensity of this effect depends on the type of concrete and the type of debris—metals or reactor fuel. This scenario of debris/concrete interaction remains hypothetical. At TMI meltdown stopped before the debris penetrated the reactor vessel. Even at Chernobyl, the heat-absorbing qualities of graphite and the Soviets' accident-management efforts are believed to have prevented debris from reaching the concrete reactor foundation, according to Powers.

While all these chemical advances hold promise, study of the chemistry of major nuclear accidents still faces major obstacles. Laboratory experiments to model the many different chemical events that may take place during a severe accident are



difficult to perform: temperatures have to be high, and many of the materials are extremely radioactive. Extrapolating from those experiments to the large-scale environment of a real reactor is even more difficult. Simulating a full core meltdown is especially troublesome. George Parker of Oak Ridge National Laboratory has reported experiments involving about 20 pounds of melt, and Powers' group at Sandia has done studies with about 500 pounds, compared to an estimated 20 tons of debris created at TMI.

Despite the experimental difficulties, the symposium's tone was optimistic. Knowing what happens during an accident is the first step toward reactor designs and operating

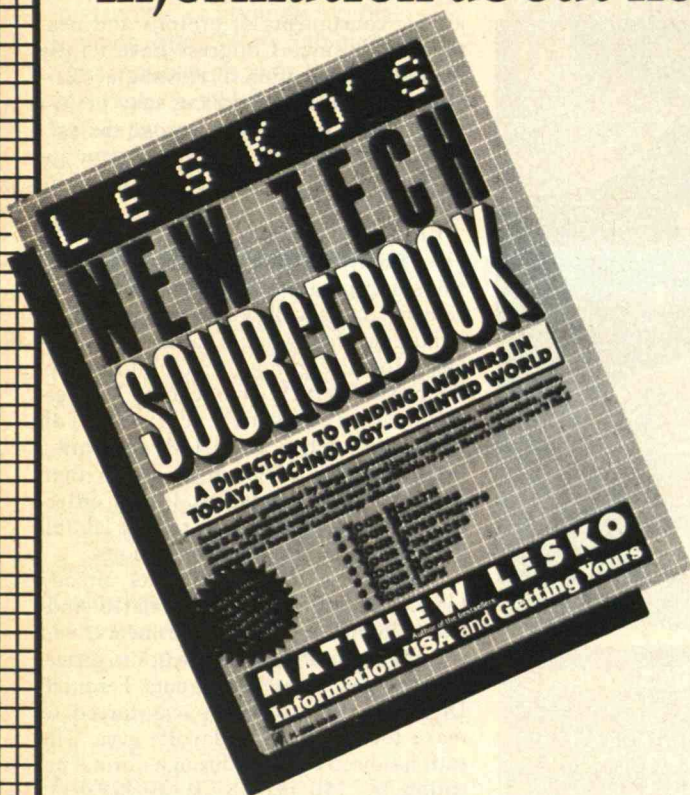
systems in which the chemistry works for us instead of against us, says Powers.

The field is too new to affect the immediate future of nuclear power. But already some operating improvements can be made in existing reactors, says Powers—for example, additives to cooling water could keep certain radioactive gases from escaping. Should the United States again build reactors, engineers will be able to take advantage of other chemical reactions that mitigate accident effects. For example, reactors could be designed and operated so as to optimize the chemical conditions that trap radioactive materials. □

JOHN MATTILL is editor-in-chief of Technology Review.

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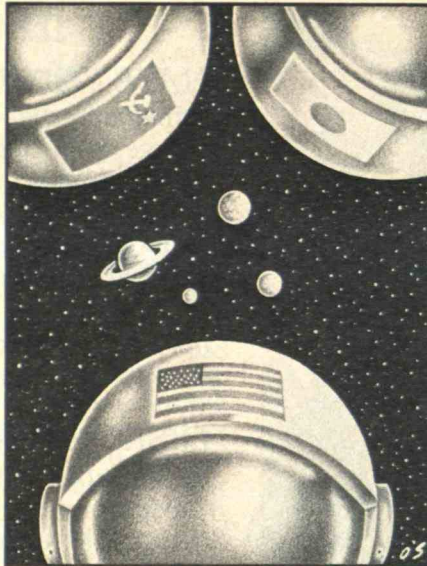
DURING the annual ritual of congressional budget hearings, space scientists and high-energy physicists have been trekking to Capitol Hill to protect and, if possible, increase their shares of the federal pie. This year, the physicists are asking for a particularly expensive item—a \$4.4 billion supercolliding superconductor (ssc), which would be the most powerful particle accelerator in the world.

This time the scientists' well-reasoned pleas for more money may not prevail. Even without the overarching concern for the federal deficit, their requests would be in trouble. Something more fundamental than shifting budget priorities is involved.

The cost of doing frontline research in these fields has grown 10-fold in the past 15 years. In fact, you could say that the fields of big science have undergone a metamorphosis. The scale on which they now must operate has grown so vast that no single nation can afford to meet their legitimate needs.

Space science is a victim of its own success. The pioneering missions of the 1960s and 1970s opened new research frontiers at costs of hundreds of millions of dollars. The sophisticated missions needed to follow up on those early discoveries run to over a billion dollars apiece. In addition to the \$1.4 billion Hubble Space Telescope, now awaiting launch, other components of the "Great Observatory Series" remain a top funding priority for astronomers. They include the \$1 billion Advanced X-ray Astrophysics Facility (see "X-Ray Astronomy Past and Future," page 66), and the Gamma Ray Observatory and Space Infrared Telescope Facility at \$500 million each.

All these observatories, which would be launched and serviced by shuttle astronauts, need extensive ground support. The annual operating and maintenance costs for the Hubble telescope are estimated to be \$150 million. The other observatories would require similar operating budgets, and this is to say nothing of the new planetary probes and the next phase of Earth-



N*o single country can afford to pursue every big project in space and particle physics.*

observing satellites.

At this writing, the National Academy of Sciences Space Science Board was nearly ready to publish its recommendations for missions to be launched from 1995 to 2015. Projects in the astronomy and astrophysics category alone would need an annual budget of \$1 billion to \$1.5 billion. NASA's science and applications budget—which has been about \$1.5 billion—simply can't handle such projected increases. And it's unrealistic to expect it to do so. The cost of doing space science in a comprehensive way has grown beyond the means of a single nation.

New Accelerators Standing Idle

American high-energy physicists are facing similar frustrations. They're elated over the Reagan administration's willingness to fight for the ssc, which would boost the energy level for studying particle collisions some 20-fold and may reveal new interactions among quarks, the sub-

atomic constituents of protons and neutrons. But since Congress hasn't fully funded the operation of existing accelerators, the physicists' dreams may be just that. Were Congress to approve the ssc, which is not certain, they could gain another front-rank facility without the money to make the most of it.

Consider Fermilab at Batavia, Ill. Its new \$500 million Tevatron has begun smashing protons and antiprotons together at a total collisional energy of 1,800 billion electron volts. That's the highest laboratory energy now available for studying proton particle interactions. Yet Fermilab struggles to exert research leadership with a fiscal-1987 operating budget of only \$171 million rather than the \$191 million requested. It's the difference between being able to run the lab full tilt and having to curtail operations.

Major Tevatron experiments already planned are proceeding. But related studies, planning for new experiments, and general engineering design work is suffering. Because of the budget cuts, Fermilab Director Leon Lederman was forced to make the center's first layoffs ever. The staff has been reduced through normal attrition by 150 people as of March 1. "We're just praying we can keep this machine on right through the fiscal year," Lederman says.

Burton Richter, director of the Stanford Linear Accelerator Center (SLAC), cannot even hope for that much. SLAC's newly completed machine stands ready to provide the world's most energetic electron-positron interactions at collisional energies of 100 GeV. That's one of the highest energies available for studying this type of particle. However, the accelerator will be able to run only for three months or less this year because Congress cut SLAC's 1987 budget from a requested \$115 million to \$88 million.

To quote Lederman, an outspoken proponent of the ssc, starving the operating budget is "no way to bring on a world-class machine." Yet that's exactly what could happen if Congress approves the ssc without adequate provision for the operating costs. The annual operating budget of the ssc is estimated at \$270 million. At this point, there isn't even a 1988 budget provision for the \$35 million needed to continue developmental studies if Congress authorizes the project. The Department

Continued on page 78



ROBERT C. COWEN IS SCIENCE EDITOR OF THE CHRISTIAN SCIENCE MONITOR AND FORMER PRESIDENT OF THE NATIONAL ASSOCIATION OF SCIENCE WRITERS.

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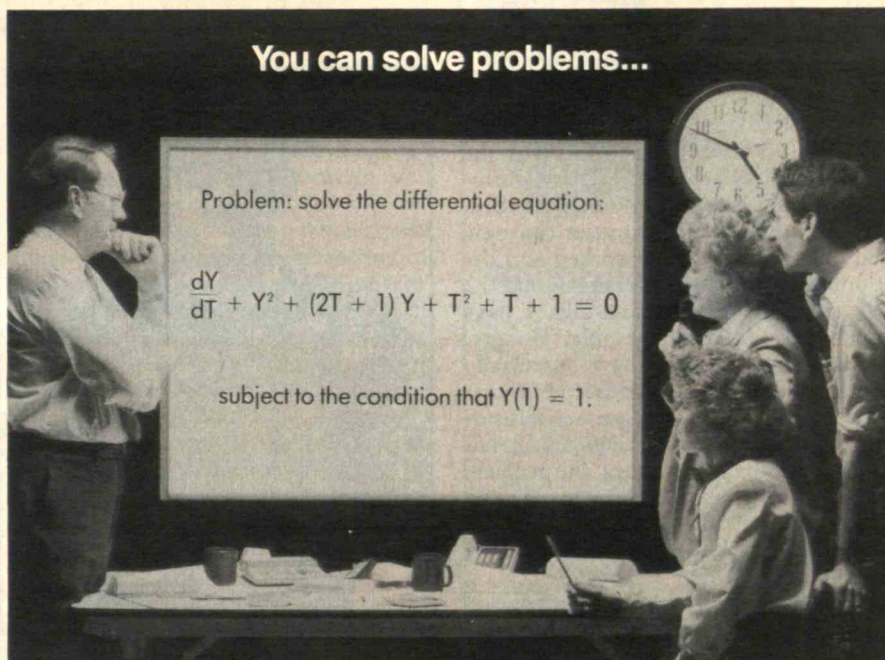
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```
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(C2) DIFF(Y,T)+Y^2+(2*T+1)*Y+T^2+T+1;
(D2)  dY/dT + Y^2 + (2T + 1)Y + T^2 + T + 1
(C3) SOLN:ODE(D2,Y,T);
(D3)  Y = - (%C %E^T - T - 1) / (%C %E^T - 1)
(C4) SOLVE(SUBST([Y=1,T=1],D3),%C),NUMER;
(D4)  [%C = 0.5518192]
(C5) SPECIFIC.SOLN:SUBST(D4,SOLN);
(D5) Y = - 0.5518192 %E^T - T - 1 / 0.5518192 %E^T - 1
```

and Numerically.

```
(C6) FORTRAN(D5)$
      Y = - (0.5518192*T*EXP(T) - T - 1)
      1 / (0.5518192*EXP(T) - 1)
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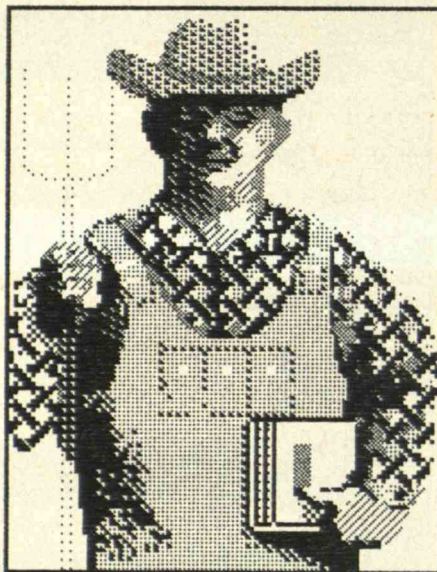
THE crisis in American agriculture is the down side to what from a global viewpoint is a major technological breakthrough. In most of the underdeveloped world, the Green Revolution of the 1960s and 1970s has worked. Many less developed countries can now feed themselves. Having worked as a development economist in Pakistan in 1972 and returned there periodically, I have found these gains remarkable. Hungry, malnourished children have essentially disappeared from the landscape in that country. In nations that are not self-sufficient, such as the Soviet Union and countries just south of the Sahara, the problem is clearly one of efficiently organizing and distributing agricultural products. It is not a question of knowing how to grow enough food.

Wealthy countries have also made significant gains. In a decade Europe has gone from importing 25 million tons of grain per year to exporting 16 million tons of grain annually. Traditional exporters such as Argentina and Brazil have also increased their output. Foreign grain production has increased in the 1980s by 29 million tons per year. Yet worldwide consumption has grown by only 19 million tons per year. The net result is a worldwide oversupply of food — clearly a good thing for human welfare. There are still those who cannot afford to buy food, but there is no shortage of food to be bought.

What is good for human welfare is bad for the American farmer. In the late 1970s American farmers were exporting 60 percent of their wheat, 40 percent of their rice, soybeans, and cotton, and 25 percent of their corn. In 1981 the United States boasted net agricultural exports of \$27 billion. But by 1986 net exports had dropped to \$4 billion. In 1987 agricultural exports may well be negative: more tropical products will be imported than temperate products exported.

The Shrinking Farm Belt

Many American farmers dream of returning to the prosperous world of the late



As the American farm belt shrinks, the government must help ease farmers into new jobs.

1970s, but that world is gone. It is not a question of hanging on until export markets recover. They are not going to recover in the foreseeable future. Furthermore, the large productivity advantages that American farmers used to enjoy are gone. European farmers are more efficient than they used to be, and their productivity is higher than their American counterparts in some farming sectors such as dairying. That is largely because European farmers have been in a better financial position in the last five years and thus able to purchase state-of-the-art equipment.

Unfortunately, no one wants to face up to the new reality: American agriculture is going to have to shrink. Not only will many farmers have to go out of business, but a great deal of land will have to go out of cultivation. There is simply too much land being farmed in the United States given the declining export market.

Initially, the least productive land for each crop—often concentrated in partic-

ular parts of the country—will no longer be used. Much of eastern Colorado, for instance, is marginal for growing wheat. Whole communities will cease to exist as the surrounding land becomes worthless unless they lie close to urban areas that generate industrial or recreational uses.

Farmers are not the only ones who will suffer from the collapse of the export market. Those who supply farmers with the inputs necessary to farm and live will also find they have fewer job options, as will those who process or transport agricultural products.

One has only to look at the earlier experience of northern New England to see what will happen to the farm belt. As more productive farmland in the Midwest came into production during the twentieth century, the agricultural land in northern New England became worthless.

So what can be done? There are several options, none particularly attractive. In the international trade talks now going on, some nations are pushing to open all agricultural markets to free trade. (See this space, February/March 1987.) Whether American farmers would be better off in a world of free trade is difficult to tell.

While free trade between the United States and Europe would probably help Kansas farmers export more wheat, it would destroy the Wisconsin farmers' domestic market for dairy products (since European dairy farmers can now undercut American prices). Opening Japan to rice imports might end up helping Thailand rice farmers and not American rice farmers. We do know that with unsubsidized free trade, American farmers would lose the average \$16,000 they now get from the U.S. taxpayer. The free market would drive farmers and their land out of production — with a lot of pain and suffering.

A Taxpayers' Revolt

U.S. taxpayers could continue to pour huge sums into subsidizing an economically non-viable way of life. However, no one believes such subsidies are politically feasible in the long run. At some point urban taxpayers will revolt and refuse to pay the sums that are required for farm subsidies. In 1986 the federal government spent \$26 billion on price or income supports and another \$14 billion for other farm programs. That \$40 billion dollars



LESTER C. THUROW IS THE NEWLY APPOINTED DEAN OF THE SLOAN SCHOOL OF MANAGEMENT AT M.I.T.

is a lot of money, yet it essentially contributes nothing to solving the problem. Next year's farm subsidies will need to be equally large and, as they are now structured, will be equally ineffective.

There is only one realistic option: organize a system of transitional aid to help farmers and surrounding communities as farming declines. This option, of course, is not attractive politically since those who would be aided by such a program don't want to leave farming. Furthermore, those who represent farmers don't wish to see them leave. As farm states become depopulated, some of the politicians will lose their constituents and their jobs.

Despite the inevitable political repercussions, the U.S. government should take the lead in easing farmers out of agriculture. Those in farming and related industries

should be retrained and relocated (voluntarily, of course) to areas where jobs are available. The sum that we now spend on farm subsidies would go a long way toward paying for such programs. In areas of marginal agricultural production such as north-central Montana, whole farms should be purchased and permanently retired from production. The U.S. government is already buying dairy cows in an effort to ease dairy farmers out of an overcrowded market. There's no reason why we can't do the same for land.

To do what we now do — pay farmers not to produce — is to pretend that at some point in the not-too-distant future these farmers and their land will go back into production. This sort of system discourages the very transitions that must be encouraged. □

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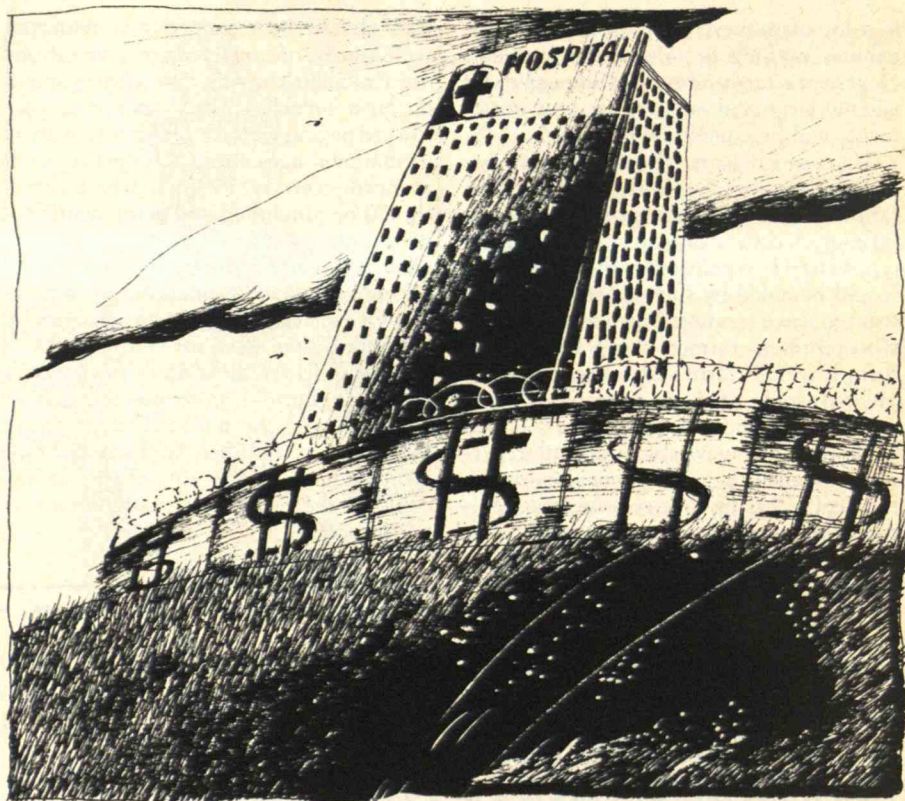
THE hope has long been held that the flood of modern medical technology would contribute equitably to all society, raising all boats together. Yet a troubling gap in health and health services between the rich and poor continues. This discrepancy is worst between the world's rich and poor nations, but even within many industrialized nations, including the United States, the gap either continues or is actually widening. Some industrialized nations such as the Scandinavian countries are eliminating this disparity through human services and national health programs. We need a similar approach in the United States if we are to prevent advances in medical technology from being used to maintain or widen the gap.

A comparison of the poor's access to medical treatment with that of the rest of the U.S. population indicates that the system needs changing. Coverage by health insurance has rapidly worsened since the mid-1970s. In 1977, 25 million people in the United States lacked medical insurance. Today, more than 35 million people lack such coverage, and millions more have grossly inadequate plans.

Medicaid, the state/federal insurance program for the poor, was supposed to bring the uninsured into the mainstream of medical care when it was introduced in the 1960s. But even at Medicaid's high point in the mid-1970s, it covered only 65 percent of those living below the poverty line, because of eligibility restrictions imposed by the states. Since then states have further tightened these requirements, so Medicaid now covers only 52 percent of those living below the poverty level.

In some states fewer than 20 percent of those living in extreme poverty are eligible for Medicaid. Even those who are covered may have trouble getting access to care since a large percent of physicians simply refuse to serve them. Doctors complain about relatively small reimbursements and long delays in payment by the government.

Declining access to care is also related



to an increase in the number of people living in poverty. Today, one in every four U.S. children below the age of six lives in poverty, with one of every two black children in that age span in this plight. The bottom 40 percent of our population receives 15.7 percent of the national income—the smallest percentage since the statistic was first collected in 1947.

Losing Out on Medical Treatment

The effects of this increasing disparity in income and access to health care are predictable. Some 38 percent of pregnant black Americans start prenatal care—which includes nutritional instruction and fetal monitoring—after the first three months of pregnancy. This is inadequate; less than 20 percent of white pregnant women start prenatal care after this critical period. Failure to obtain early and complete prenatal care is an important factor in disability and death among newborns.

Both the Carter and Reagan administrations set goals of reducing the 38 per-

cent to 10 percent by 1990. But if current trends continue, the figure will have fallen only to 35 percent by then. Each administration failed to provide enough funds for prenatal care and other services; the Reagan years have been particularly lean.

Lack of prenatal and basic postnatal care and decent food, housing, and parental education increases infant mortality. That is why it is widely used as an indicator of a society's health. The U.S. infant mortality rate has stopped decreasing significantly, and in many areas the gap between rich and poor appears to be growing—even where infant mortality has declined. In the poor, largely minority-populated South Bronx, for example, infant mortality was 19 percent higher than in the rest of New York City in the early 1970s. In the early 1980s, it was 36 percent higher in the South Bronx, even though it had declined in both areas.

It makes little difference that most infants with acute medical problems probably have access to high-tech neonatal care. If an acutely ill infant needs a respirator or other costly equipment, it can

VICTOR W. SIDEL, M.D., is Distinguished University Professor of Social Medicine at Montefiore Medical Center/Albert Einstein College of Medicine in New York City, president of Physicians for Social Responsibility, and past president of the American Public Health Association.

usually be found. But the most advanced medical technology, although it unquestionably saves lives, is not the most important determinant in whether infants survive and thrive. Better prenatal and basic postnatal care and improved social conditions are far more critical, yet these measures take second place to technological fixes. Hospitals can usually find the funds to buy high-tech equipment, but there are few sources of money for basic care.

Among adults, poverty and inadequate preventive medicine and primary health care translate into more illness. Essentially all chronic illnesses—heart disease, arthritis, rheumatism, hypertension, asthma, diabetes, and emphysema—are at least twice as prevalent among low-income people as within the general population. The cycle is vicious: the poor become sick; the sick, poor.

Thus, the poor are likely to need medical technology more but often have less access to it. For example, cesarean sections are much more likely to be performed on middle-class and wealthy women than on the poor. While some cesarean sections may be unnecessary—almost one of every five U.S. babies is delivered in this manner—the technique is usually used when doctors are concerned about the baby's or mother's health. The irony is that poor women, who have a greater chance of having high-risk pregnancies, are less likely to obtain this procedure.

A particularly dramatic example of class bias in access to medical technology is provided in a late-1970s study of coronary-bypass grafting procedures conducted in Buffalo, N.Y. For men aged 45 to 64 in the lowest quartile of median family income, the annual rate of coronary-artery surgery was 1.7 per 1,000. For men whose family income was above the median level, the rate was 3.8 per 1,000—more than twice as high. The value of this technique is controversial, but there is strong evidence that the procedure offers some relief from symptoms. And the need for the surgery may be greater among poor men since they are more likely to have heart disease.

The federal government's new system of paying fixed amounts for hospital stays for various diagnoses also affects the poor, since it has meant that some patients are discharged too early or are denied medical procedures. Affluent patients are usually

*The poor
are more likely
to need medical technology
but are less likely
to have access
to it.*

in a much better position to insist on full hospital stays and more procedures. Furthermore, this system encourages private hospitals to send the poor to public hospitals, which may not have the most advanced medical technologies. Private hospitals know that poor individuals tend to need treatment that costs more than the government will pay for, since they often wait longer before seeking treatment.

While accepted medical technologies are often not as available to the poor, low-income individuals have often served as guinea pigs for testing new procedures. Oral and intrauterine contraceptive devices were originally tested on poor women, often without informed consent.

Since the early 1970s, all research institutions have been required to use better informed-consent procedures and to set up institutional review boards for protection of human subjects. These requirements have largely eliminated the practice of primarily testing medical technology on the poor, but class bias still affects this research. Many research hospitals serve predominantly inner-city populations, and poor or minority patients may not fully understand a study or may feel pressured to participate. Also, payments to research subjects are most likely to induce the poor to participate. Review boards are obligated to look into these matters, but often the problems are difficult to control.

Creating a National Health Program

In our wealthy society we could equitably provide both advanced medical treatment and more preventive and basic health care if we chose to. Models exist in other countries for a better health-care system. Sweden, which has a strong national health-insurance system, provides one example. That country spends about the same percent of its GNP on health care as the

United States—roughly 11 percent.

Sweden's health-insurance system, financed by county taxes, requires patients to pay only about 4 percent of the cost of medical care directly. By contrast, U.S. patients pay about 30 percent directly.

Sweden's health-care facilities, stocked with technologies at least as good as those in the United States, are government-owned. Hospitals are regionalized so they can assure that medical technology will be available yet avoid the duplication and unnecessary use common in the United States. While privately insured patients can enter any U.S. hospital, Swedish patients are directed to the hospital that offers the appropriate level of care. The simplest treatments are available at county hospitals, while more expensive, exotic medical technologies are provided by district and regional hospitals.

The Swedish medical budget does not drain money from basic care. Consider how prenatal care works. By the end of the first trimester of pregnancy, 99 percent of Swedish women are registered in the country's free prenatal programs. During the ninth month of pregnancy, a public-health nurse—or, if the pregnancy has been complicated, a physician—visits the home to make sure everything is ready for the child. A month after delivery, a health-care professional again visits to make sure the child is doing well.

Skeptics argue that since Sweden has a smaller percentage of poor and sick people than the United States, it is easier to care for them. But the percentage is lower because medical care and other social benefits are more equitably provided. These benefits help explain the country's low rate of 7 infant deaths per 1,000 live births. The U.S. rate, 50 percent higher, has not decreased significantly since 1984.

I argue for a strong U.S. health program—insurance for all that reimburses providers who maintain strong quality control, or a national health service staffed by government employees. Regionalization of hospitals, based on strong planning to meet public-health needs, would be required. Such a program would ensure that the poor have full access to the health services they require. The developers of medical technologies should encourage the government to take action. I believe they have a responsibility to see that their products are more equitably used. □

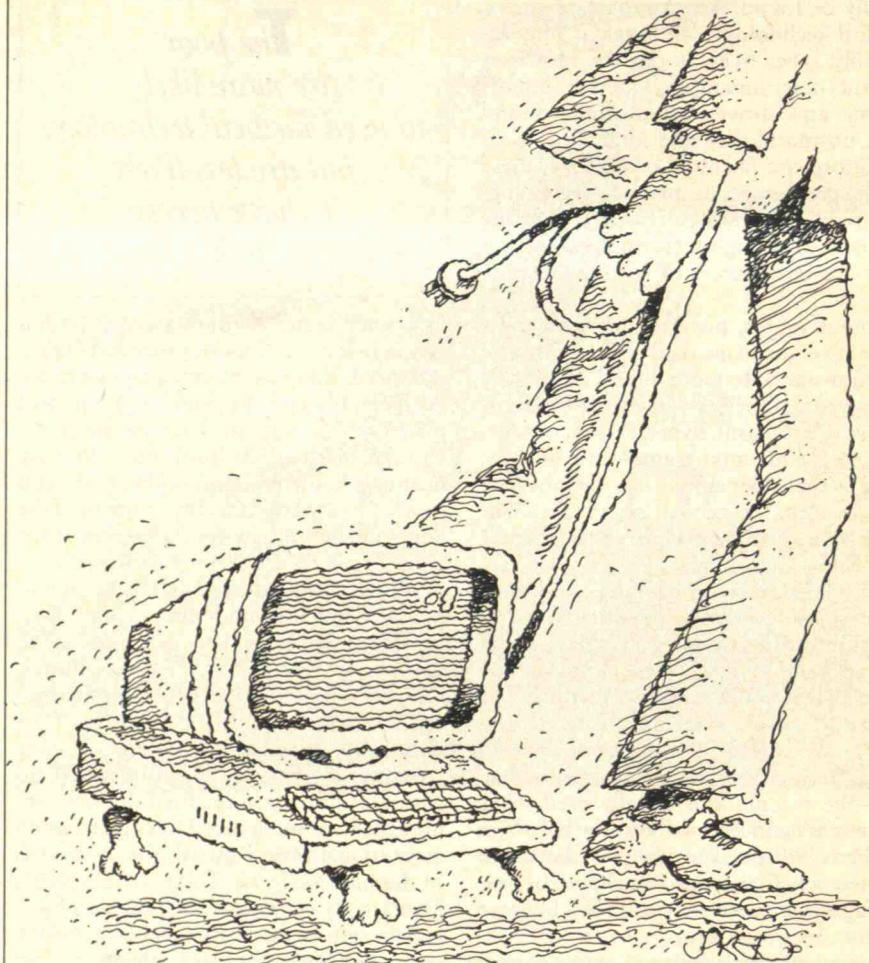
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The Information Age, for all its potential, has brought with it a new kind of problem. Often, the machines that contribute so much to the flood of information do little to help most of us cope with it. They are difficult to use, rigid in their demands, almost arrogant in their inability to work with any but their own kind. They are the muscle-bound tools of specialists.

In our view, the problem is not that the machines are too powerful for the rest of us. They are not powerful enough.

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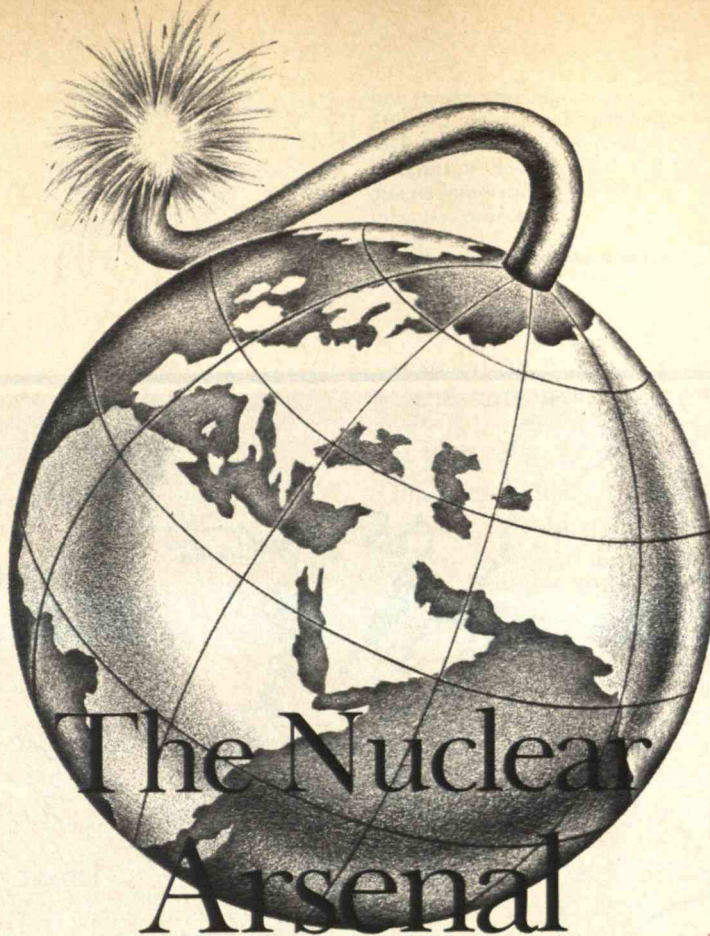
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The Nuclear Arsenal in the Middle East

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BY FRANK BARNABY

NEITHER superpower is likely to start a nuclear war by attacking the other out of the blue. It is more likely that a conflict in a Third World region between client states of the superpowers would escalate to a global scale. And the region where this escalation would most probably begin is the Middle East.

The dangers of escalation stem from the superpowers' involvement in the Third World, particularly the arms trade. Most of the weapons used in conflicts in the Third World are supplied by the United States and the Soviet Union. Because modern war uses weapons, particularly missiles, at a great rate, supplies must flow continually, as was shown dramatically in the October 1973 Middle East war. Both Egypt and Israel ran short of weapons within

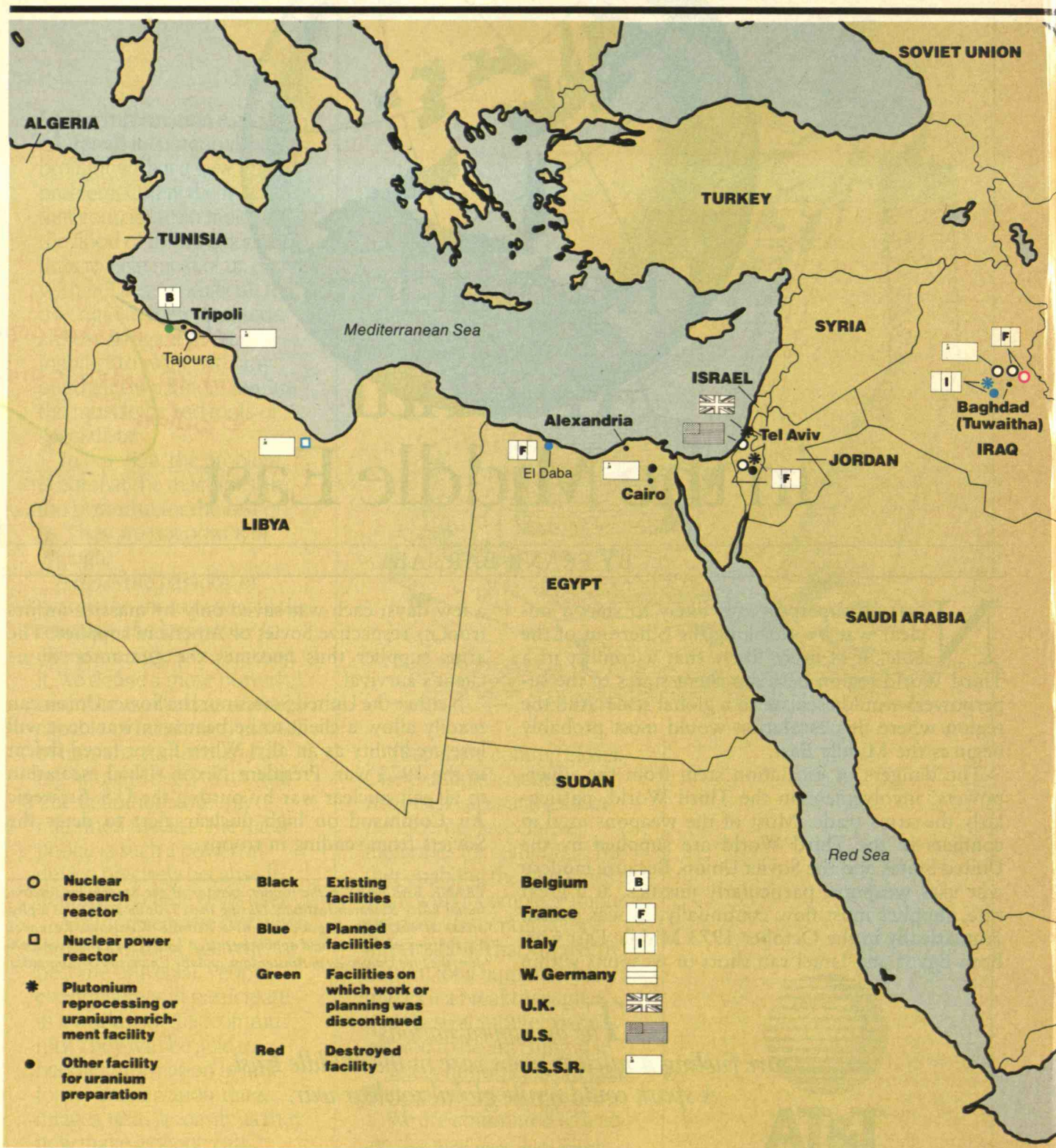
a few days; each was saved only by massive airlifts from its respective Soviet or American supplier. The arms supplier thus becomes the guarantor of its client's survival.

Neither the United States nor the Soviet Union can readily allow a client to be beaten in war or it will lose credibility as an ally. When Egypt faced defeat in the 1973 war, President Nixon risked escalation to all-out nuclear war by putting the U.S. Strategic Air Command on high nuclear alert to deter the Soviets from sending in troops.

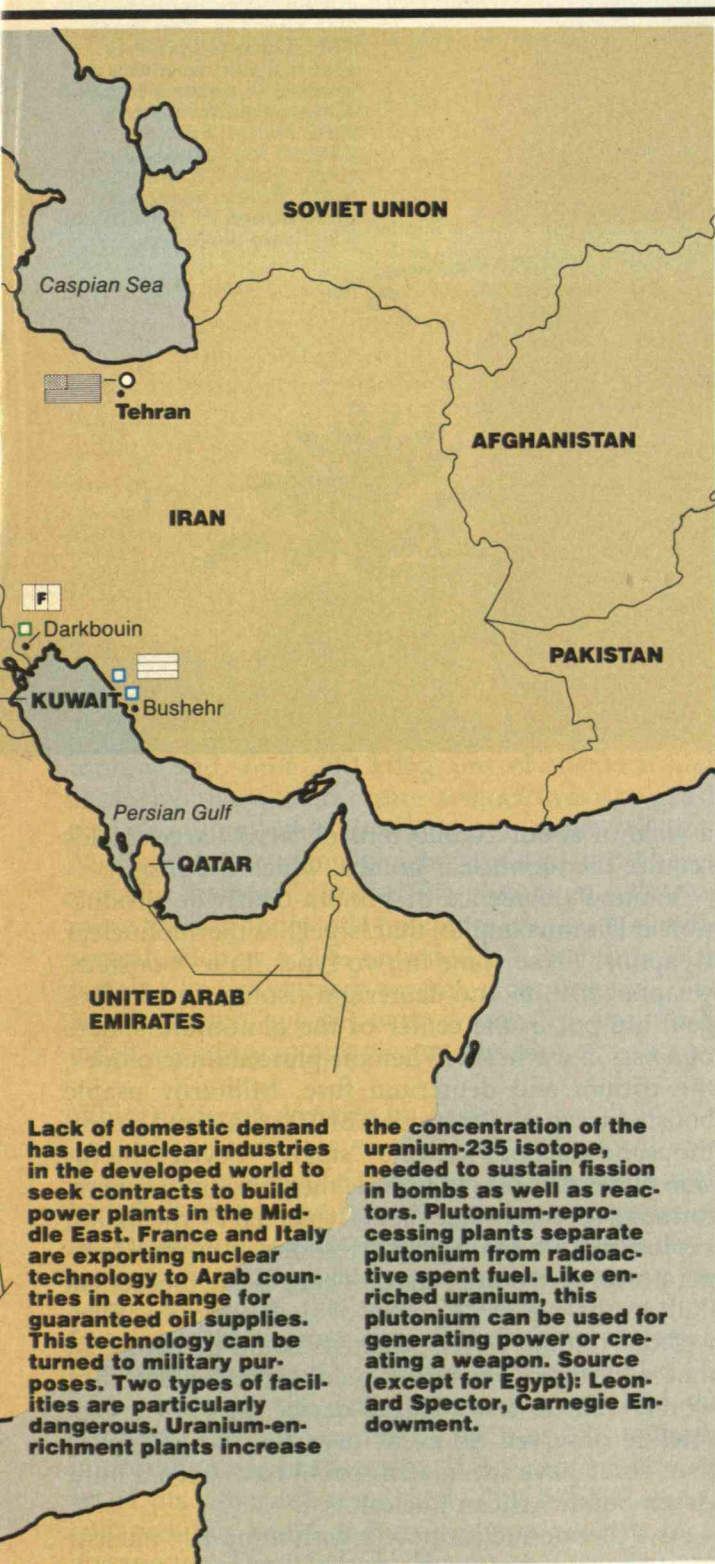
FRANK BARNABY is the former director of the Stockholm International Peace Research Institute. During the 1950s he worked as a physicist at the British government's Atomic Weapons Research Establishment. He has held appointments at University College in London, the Free University in Amsterdam, and the University of Minnesota.

*The developed nations
are fueling a nuclear arms race in the Middle East.
A spark could ignite global nuclear war.*

ILLUSTRATION: JOHN O'SULLIVAN



In a future issue Marvin M. Miller, a physicist who has long been concerned with nuclear-weapons proliferation, will discuss international efforts to solve this problem.



Escalation to nuclear world war is most likely if a client state first resorts to its own nuclear weapons, and nuclear weapons are beginning to proliferate in the Middle East. Last October the London *Sunday Times* published the revelations of Mordechai Vanunu, the 31-year-old technician who worked for 10 years at Israel's nuclear establishment in Dimona and who was later abducted to Israel. Vanunu implies that Israel has a nuclear arsenal comparable to that of China, France, or the United Kingdom. Iraq has also sought to make a nuclear weapon, and Libya and Egypt have cultivated their nuclear technologies to the point where they could well make nuclear weapons. Even a subnational group such as the Palestine Liberation Organization (PLO) might produce a nuclear weapon.

Much of the Middle East's nuclear technology was imported from developed nations, ostensibly for power plants and other peaceful purposes. Nuclear-weapons proliferation will be checked only when developed nations take into account that any nuclear technology can be adapted to military use. Such technology should not be exported without safeguards to ensure that it is used for its intended purpose. And the superpowers must reduce their own nuclear arsenals if they expect client nations in the Third World to forego acquiring such weapons.

Israel's Nuclear Program

International interest in Israel's nuclear arsenal has been rekindled by Vanunu's revelations. Prior information from the U.S. Central Intelligence Agency suggested that Israel might have two dozen fission bombs of the type dropped on Nagasaki. *Time* reported that during the October 1973 war, Israeli Prime Minister Golda Meir ordered nuclear warheads deployed. There has been speculation that the Soviet Union responded by sending nuclear warheads to Egypt.

Before publishing Vanunu's story, the *Sunday Times* asked me to check its technical accuracy, and I was convinced. During our interview, Vanunu showed me some 60 photographs of the nuclear operations at Dimona and various models of the bomb. One photo showed the production of lithium deuteride, a compound used almost exclusively for thermonuclear, or fusion, bombs. His descriptions of plutonium processing were accurate, although they could have been gleaned from unclassified sources.

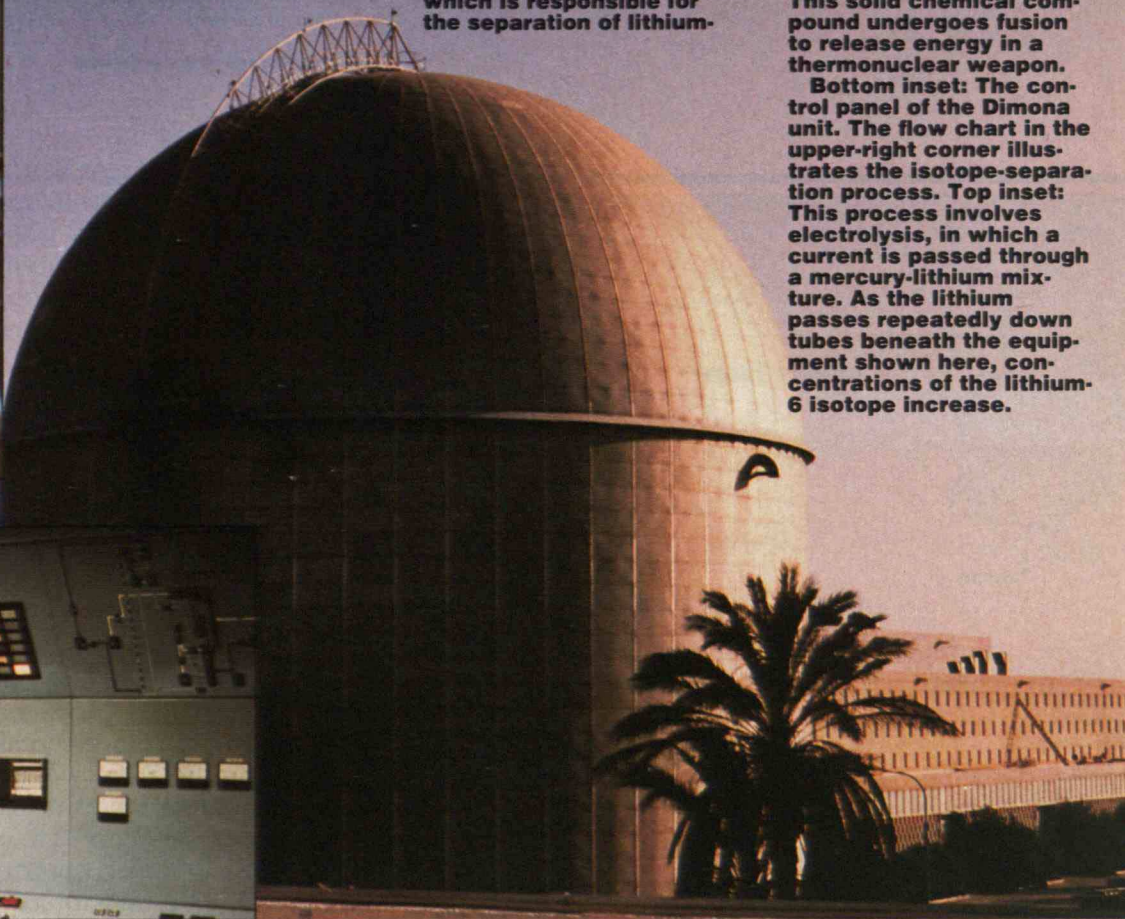
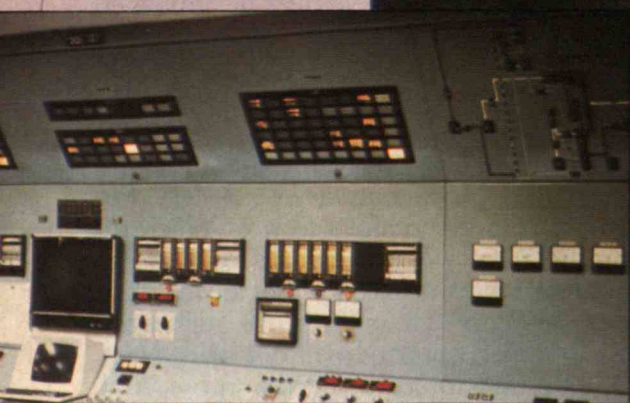


Last October Mordechai Vanunu, an Israeli technician, revealed that Israel has a sophisticated nuclear arsenal. These pho-

tos provided important evidence to the author, who was asked to verify Vanunu's story. They depict the Dimona unit, which is responsible for the separation of lithium-

6, a rare isotope of lithium. Lithium-6 is combined with deuterium, an isotope of hydrogen, to form lithium deuteride. This solid chemical compound undergoes fusion to release energy in a thermonuclear weapon.

Bottom inset: The control panel of the Dimona unit. The flow chart in the upper-right corner illustrates the isotope-separation process. Top inset: This process involves electrolysis, in which a current is passed through a mercury-lithium mixture. As the lithium passes repeatedly down tubes beneath the equipment shown here, concentrations of the lithium-6 isotope increase.



His detailed descriptions of lithium-deuteride production, however, could have been gained only firsthand. Particularly convincing was his explanation of how lithium-6, the isotope needed for thermonuclear weapons, is separated from ordinary lithium.

The fact that the Israelis lured Vanunu from London to Rome and abducted him to Israel for trial adds to his credibility. Israeli authorities would have been unlikely to mount a sophisticated intelligence operation and embarrass the Italian government if Vanunu's story were not true.

According to Vanunu, for 10 and possibly 20 years Israel has been producing about 30 kilograms of weapons-grade plutonium annually at Dimona. This means that the capacity of the reactor is about five times greater than it was previously thought to be. Vanunu also claims that about 4 kilograms of plutonium go into each Israeli nuclear weapon. Thus Israel could produce about 7 nuclear weapons a year and may now have well over 100.

Plutonium could be used to make fission weapons of the Nagasaki type. It is impractical to produce weapons of this type that will have a yield greater than 50,000 tons of TNT. (The Nagasaki bomb had

a yield of about 20,000 tons of TNT.) Larger yields require thermonuclear bombs, which use fusion.

Vanunu's evidence of lithium-deuteride production at Dimona implies that Israel has thermonuclear weapons. These come in two types. In a "boosted" weapon, tritium and deuterium (isotopes of hydrogen) are put in the center of the plutonium sphere of a fission warhead. When the plutonium explodes, the tritium and deuterium fuse. Militarily usable boosted weapons have yields of 100 thousand to 200 thousand tons of TNT. In a "staged" device, the fusion material is placed outside the plutonium sphere, forming a second stage that is triggered by the fission explosion. Lithium deuteride, a solid at normal temperatures, is typically used. There is no theoretical limit to the explosive power of such weapons. Even without testing, Israeli scientists could be confident that a boosted weapon would explode. But they would want to test a staged device. In 1979 a U.S. satellite observed an event over the Indian Ocean that, some have speculated, could have been a joint Israeli-South African nuclear test.

As a thermonuclear power with some 100 nuclear weapons, Israel is in the same league with China,

*Iraq appears to be producing
the deadly nerve agents Sarin and Tabun,
each at a rate of four tons a month.*

France, and the United Kingdom. Each has a few hundred nuclear weapons, including some thermonuclear weapons.

In 1963 France, not greatly concerned about providing nuclear-weapons technology to a then-friendly country, secretly supplied Israel with the Dimona reactor. The reactor may be fueled with natural uranium dug from the ground, which has 0.7 percent of the U-235 isotope that most easily undergoes fission. Or it may be fueled with uranium enriched to have a slightly higher U-235 content. The spent fuel elements of a reactor contain unused uranium, radioactive fission products, and plutonium. France further helped Israel build a reprocessing facility to separate the plutonium from the rest of the used fuel, and this is the material that Israel uses for nuclear weapons. Apart from this initial assistance, Israel designed and manufactured its nuclear force indigenously.

Israel, and for that matter other Middle Eastern powers, could easily deliver nuclear weapons to targets in the region. Even a fairly crude modern nuclear weapon would probably weigh much less than 800 kilograms. It would contain a few kilograms of plutonium and some 200 kilograms of chemical high explosive that would create a shock wave to crush the plutonium, thus producing a chain reaction. Much of the remaining weight would go into a heavy metallic "tamper" around the plutonium, allowing more fissions and producing more energy. A combat aircraft such as a U.S.-supplied F-4 Phantom or an Israeli Kfir could carry several such weapons. The Israeli Jericho missile, with a range of about 200 miles, could carry one such warhead.

Why Did Israel Acquire Its Arsenal?

With a population of 4.3 million, Israel is confronted by heavily armed Arab states with a total population of 90 million. Concerned with its security, Israel embarked on a nuclear-weapons program in the 1960s. Of course, the United States would not allow Israel to be devastated, not only because of the moral obligation imposed by the Holocaust, but also because Israel is the only true democracy and the strongest U.S. ally in one of the most strategically important areas of the globe. If America abandoned Israel, its other alliances, including NATO, would collapse. But Israel does not rely on such de facto guarantees. The memory that no country was pre-

pared to help when Hitler murdered 6 million Jews makes Israelis doubt that any country would come to their aid if they were being pushed into the sea.

Because they depend on no other country in an emergency, Israelis want to be as self-sufficient as possible in weapons production, including nuclear weapons. This is especially true since both the United States and the Soviet Union have provided sophisticated weapons to Arab states, narrowing the technological gap between Israel and its enemies.

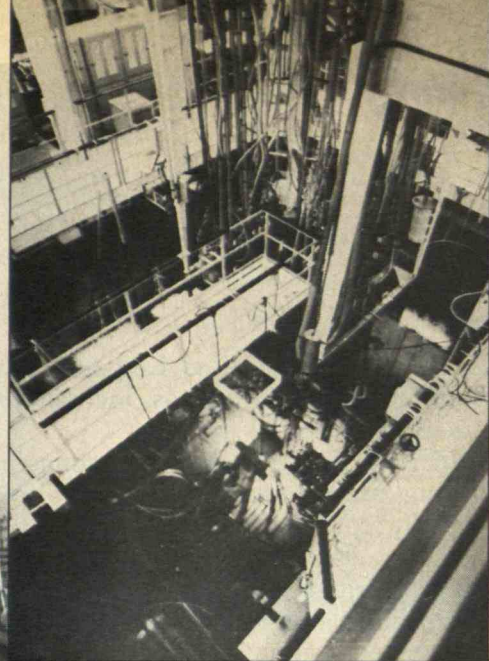
Some Israelis are bound to argue for improving nuclear weapons because Iraq has shown that it will use chemical weapons. Authoritative reports of the British Broadcasting Co. indicate that Iraq is producing 60 tons of mustard gas per month, as well as 4 tons per month of each of the deadly nerve agents Sarin and Tabun. Syria and Egypt may also have chemical weapons. Like nuclear bombs, these are weapons of mass destruction. NATO policy holds that a chemical attack on cities would justify nuclear retaliation, and Israel would probably respond similarly. However, the BBC also reports that Israel is itself producing chemical weapons.

Most commentators assume that Israel's nuclear weapons are intended as a last-ditch deterrent to military moves by Arab nations that would threaten Israel's existence. But this does not account for the size and quality of Israel's nuclear weapons. Israel could provide adequate deterrence by targeting ordinary fission weapons on major Arab cities—a dozen weapons the size of the Nagasaki bomb would suffice. No Arab city is big enough to "justify" a thermonuclear weapon.

Could Israel want a tactical nuclear arsenal—to be used, for example, against an Arab tank attack—as well as a strategic deterrent? The United States produces neutron warheads—fusion weapons designed to release high-energy neutrons to irradiate and kill tank crews. But they are basically ineffective. A simple plastic cover impregnated with boron can absorb most of the neutrons and protect the tank crew. If tanks are spaced a typical 200 meters apart, only one tank on average will be caught by a neutron warhead of reasonable yield. Finally, even if tank crews have been exposed to enough radiation to kill them, they are likely to survive for at least a few hours. During that time they would probably run amok, kamikaze fashion, doing far more damage than they would otherwise. The competent Israeli military knows the limitations of neutron warheads,

France and Italy provide nuclear technology to Arab countries to obtain guaranteed supplies of crude oil, such as is here being loaded on a tanker in the Persian Gulf. In June 1981 Israel bombed

Iraq's Osirak reactor, supplied by France and similar to the French reactor depicted in the inset. Israel feared Iraq could make nuclear weapons from the plutonium produced in the reactor.



and would surely prefer to purchase far more cost-effective conventional antitank weapons.

It is hard to imagine any legitimate tactical use for Israeli nuclear weapons. The country is so small that fallout from any detonation of nuclear weapons in the Middle East would be a major hazard for Israeli troops and civilians.

Israel has probably produced its relatively large and sophisticated nuclear force primarily because of the technological momentum of the nuclear-weapons program. To design, develop, and produce its weapons, Israel had to form a team of nuclear scientists and technologists. Such professionals want to continue pushing forward the frontiers of their field. They may sincerely believe that national security depends upon the next advance in military R&D, while bureaucratic and economic forces add to their zeal.

Other nuclear-weapons powers follow this same pattern. There is no rationale for any country to produce high-yield thermonuclear weapons. The American nuclear-weapons scientist J. Robert Oppenheimer pointed out in the late 1950s that boosted nuclear fusion weapons are powerful enough to destroy any conceivable target. But Oppenheimer was silenced, and the U.S. nuclear-weapons community,

closely followed by its Soviet counterpart, went on to produce megaton thermonuclear weapons. The United Kingdom, France, and China came next, and Israel now seems to have followed.

Arab Nuclear Weapons

Israelis naturally differ as to the wisdom of possessing nuclear weapons, and some of their views are surprising. For example, several otherwise dovish factions of the Labor Party are pronuclear because they believe that Israel can give up the West Bank if it has the security of nuclear weapons. And some hawkish factions, headed, for example, by former Defense Minister Ariel Sharon, are antinuclear because they want to increase Israel's conventional military strength.

Israel's official policy is to keep its nuclear-weapons capabilities ambiguous. No Israeli leader has ever admitted that the country has nuclear weapons. A statement by former Minister of Defense Moshe Dayan in June 1981 is one of the most explicit to date: "We are not going to be the first ones to introduce nuclear weapons into the Middle East, but we do have the capacity to produce nuclear weap-

*Several otherwise dovish factions
of Israel's Labor Party are pronuclear, and some
hawkish factions are antinuclear.*

ons," Dayan said. "If the Arabs are willing to introduce nuclear weapons into the Middle East, then Israel should not be too late in having nuclear weapons too." The statement did not make clear whether Israel merely had the necessary technological capacity, or whether it had components ready to assemble into warheads.

Such a policy has served Israeli purposes. Firm knowledge that Israel has a nuclear arsenal larger than needed for deterrence would encourage Arab states to acquire nuclear weapons, and would increase the likelihood of a preemptive Arab attack against Israeli facilities related to nuclear weapons. It would also prompt the Soviets to guarantee their Middle Eastern allies nuclear retaliation against an Israeli nuclear attack. And not least, proof of a sophisticated Israeli arsenal would complicate Israel's relations with the United States. In particular, Congress could become reluctant to supply Israel with sophisticated conventional weapons.

How will Arab nations react to Vanunu's statements implying that Israel's nuclear-weapons capability rivals that of France, England, or China? Even if technological momentum is the real reason for such developments, Arab states will assume that Israel seeks an overwhelming first-strike capability, since nations inevitably assume the worst when judging enemy intentions. Consequently, Arab states are likely to accelerate the development of their own nuclear capability. Of course, they might acquire nuclear weapons even if Israel had none.

There are relatively few obstacles to acquiring such weapons. Any Middle Eastern country could obtain natural uranium. Using materials purchased on the open market, it could clandestinely construct a small nuclear reactor fueled by natural uranium and cooled with graphite blocks. Such a reactor could produce a few kilograms of plutonium a year, enough to make a weapon the size of the Nagasaki bomb. A small reprocessing plant to remove the plutonium from the irradiated reactor fuel could also be built. Reprocessing is economically difficult on a commercial scale, but on a small scale it entails only straightforward chemistry. To make the bomb itself work, the chemical high explosives used to compress the plutonium and produce a chain reaction must be detonated with microsecond precision. This is the most difficult part of making a bomb, but a Middle East nation could succeed in doing it. The reactor, the processing plant, and an area to construct nu-

clear weapons of the Nagasaki type could be housed in a three-story building.

A Middle Eastern country could secretly produce such weapons, and would require only a few to destroy Israel. In fact, three nuclear weapons targeted on Tel Aviv, Haifa, and the coastal region between them would be enough to decimate Israel's main population centers and industry, and to destroy its most important military command centers.

Iraq, Egypt, and Libya have significant nuclear-energy programs that, if carried through, would enable them to construct nuclear weapons. Iraqi nuclear ambitions were set back in June 1981 when Israel bombed the French-supplied Osirak research reactor. Israel feared that Iraq could make nuclear weapons from the highly enriched uranium supplied by France to fuel the reactor or the plutonium produced in it. Israel's attack accorded with one of its main foreign-policy goals: to prevent the emergence of any new nuclear-weapons power in the Middle East.

Iraq's nuclear plans have also been hindered by the war with Iran, but after the war Iraq will presumably revitalize its program with French or Soviet assistance. Meanwhile, Iraq could use the enriched uranium fuel to make a nuclear weapon. Leonard Spector, an analyst of nuclear proliferation at the Carnegie Endowment for International Peace, has reported Iraqi attempts to buy plutonium illegally. Even one nuclear weapon could kill a large proportion of Israelis, and the fallout from a ground-level explosion could render much of the country uninhabitable.

Several facts suggest that Libya may be able to produce nuclear weapons within a decade. Libya plans to import nuclear reactors from the Soviet Union, and numerous students are receiving training abroad in nuclear science and technology. Libya operates a research reactor at Tajoura and has secretly provided Pakistan with nuclear assistance, including uranium obtained from Niger. Furthermore, Libya has agreements with Argentina and the Soviet Union to collaborate in developing nuclear technology. The agreements ostensibly pertain to peaceful uses, but the technology always has some military applicability. Libya's implacable hatred of Israel and support of international terrorism make its prospect of securing nuclear weapons fearsome.

Egypt would have little difficulty building nuclear weapons once it acquired a stock of plutonium. The

*Given plutonium,
even a subnational group such as the PLO
could make a nuclear explosive.*

country already has a cadre of nuclear scientists and engineers. By 1961 it had a research reactor and a flourishing nuclear research center. It is now considering bids for one or two reactors to be built near Alexandria, and it optimistically plans to build a total of eight reactors over the next 20 years.

Egypt has used political means to thwart Israeli acquisition of nuclear weapons. In the late 1960s, President Abdul Nassar secured Soviet promises of nuclear retaliation against a nuclear attack on Egypt. President Anwar Sadat sought similar U.S. guarantees in the early 1970s. Egypt has threatened Israel with a preemptive attack on nuclear-weapons facilities, and has said that it would respond to an Israeli nuclear arsenal by producing its own nuclear weapons. Egypt recently proposed that Israel join in establishing a nuclear-weapon-free zone in the Middle East.

This political approach makes sense only while Israel's nuclear policy remains ambiguous. Once the Arab world believes that Israel has a sophisticated nuclear arsenal, the policy will no longer be credible. Will Egypt then build nuclear weapons, despite the risk that Israel would destroy the production site?

The danger of preemptive attacks against nuclear-weapons sites makes the Middle East particularly unstable. A large-scale Israeli deployment of nuclear weapons could provoke a preemptive Arab attack against production sites, arsenals, and command centers. Israel would almost certainly respond to any Arab attempt to acquire nuclear weapons with a military strike such as the one on Iraq's reactor. As it loses technological superiority in conventional weaponry, Israel will be increasingly tempted to destroy suspected Arab facilities before they can produce enough material for a nuclear weapon. A preemptive strike by either side could lead to war.

The Middle East is also home to subnational groups such as the PLO. Given weapons-grade material, even these groups could make a nuclear explosive. As the U.S. Congressional Office of Technology Assessment has concluded, "A small group of people, none of whom would ever have had access to the classified literature, could possibly design and build a crude nuclear device. . . . Only modest machine-shop facilities that could be contracted for without arousing suspicion would be required. The financial resources for acquisition of [the] necessary equipment on open markets need not exceed a fraction of a million dollars."

What Can Be Done?

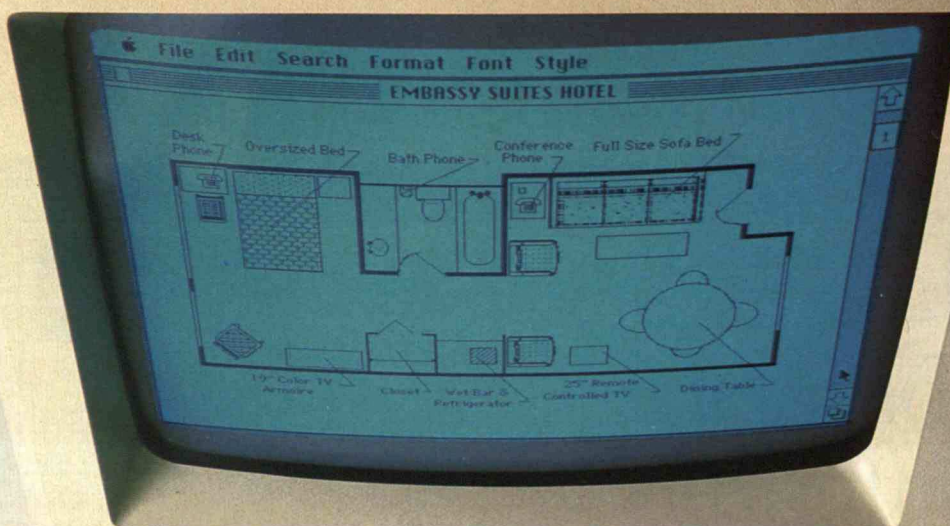
Despite the intimate relationship between the military atom and the peaceful atom, nuclear industries in the advanced countries—including the United States, France, West Germany, the United Kingdom, Italy, Japan, and the Soviet Union—are energetically trying to export nuclear power facilities to the Middle East. Except in France and the Soviet Union, nuclear industries need export orders to survive because of the lack of domestic orders for nuclear plants. And countries like France and Italy are exporting nuclear facilities and know-how to Arab countries to obtain guaranteed oil supplies.

Developed nations should not export nuclear technology unless the recipient nation signs the 1970 Nuclear Non-Proliferation Treaty (NPT) or agrees to nuclear-facility inspections required by the treaty. Such inspections help prevent the peaceful atom from being turned to military purposes.

Unfortunately, it would be almost impossible to enforce an adequate inspection system in the Middle East. The fact that some European countries are hostages to Arab oil puts pressure on them to export nuclear facilities and material to the region without adequate safeguards. Moreover, Israel will not accede to nuclear-facility inspections or sign the NPT. Doing so would require Israel to give up its nuclear advantage just when its technological lead over Arab nations is diminishing. For the same reason, the Egyptian-Israeli negotiations to achieve a nuclear-free zone in the Middle East are almost sure to flounder.

The nuclear-weapons powers could make a significant contribution toward slowing the proliferation of nuclear weapons around the world. These powers are constantly upgrading their arsenals, showing that they believe in the political and military value of nuclear weapons. They should not be surprised when other countries follow their example and acquire their own such weapons.

The need to stop nuclear proliferation is one of the strongest arguments for arms control. The NPT obligates the Soviet Union and the United States to take significant steps toward reversing the arms race and achieving nuclear disarmament. A comprehensive test ban would be a good first step. If the superpowers wish to halt nuclear proliferation in the long run, they must follow such a ban with actual nuclear disarmament. □



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WHEN Brazil's National Informatics Law of 1984 reinforced a ban on the import of many computers, the move provoked instant controversy.

Multinational computer producers had long claimed that this exclusion doomed Brazilian consumers to obsolescent and expensive equipment, and that it favored only a few local companies at consumers' expense. U.S. officials denounced the move as prejudicial to American interests and contrary to the principles of free trade.

The Brazilians responded by proclaiming the critical importance of fostering a locally controlled computer industry. They asserted that Washington was merely seeking to protect the oligopolistic power of IBM and other major U.S. corporations. U.S. computer firms derive a significant share of their revenue abroad—over 50 percent for some of the largest manufacturers. These firms naturally want to continue to dominate international trade in the industry. Although the Brazilian computer market currently is just 3 percent that of the U.S. one, it is growing by 35 percent annually. It is potentially one of the largest markets in the world.

The debate has drawn considerable attention as other countries strive to define their stance on similar questions. Some countries, such as Mexico and Argentina, have had ambitions to imitate Brazil's approach. For the past 10 years Mexico has had an on-and-off protectionist policy. In compliance with Mexico's 1981 foreign-investment laws regarding computers, Apple and Hewlett-Packard constructed plants there in which they held only minority ownership. However, pressed by the increasing burden of its foreign debt, Mexico is now trying to attract new outside investment. In 1985, in return for major concessions, the Mexican gov-

Brazil's Independent Computer Strategy

Brazil has developed its computer industry by restricting imports.

U.S. manufacturers and officials fear the model could be exported to other nations and industries.

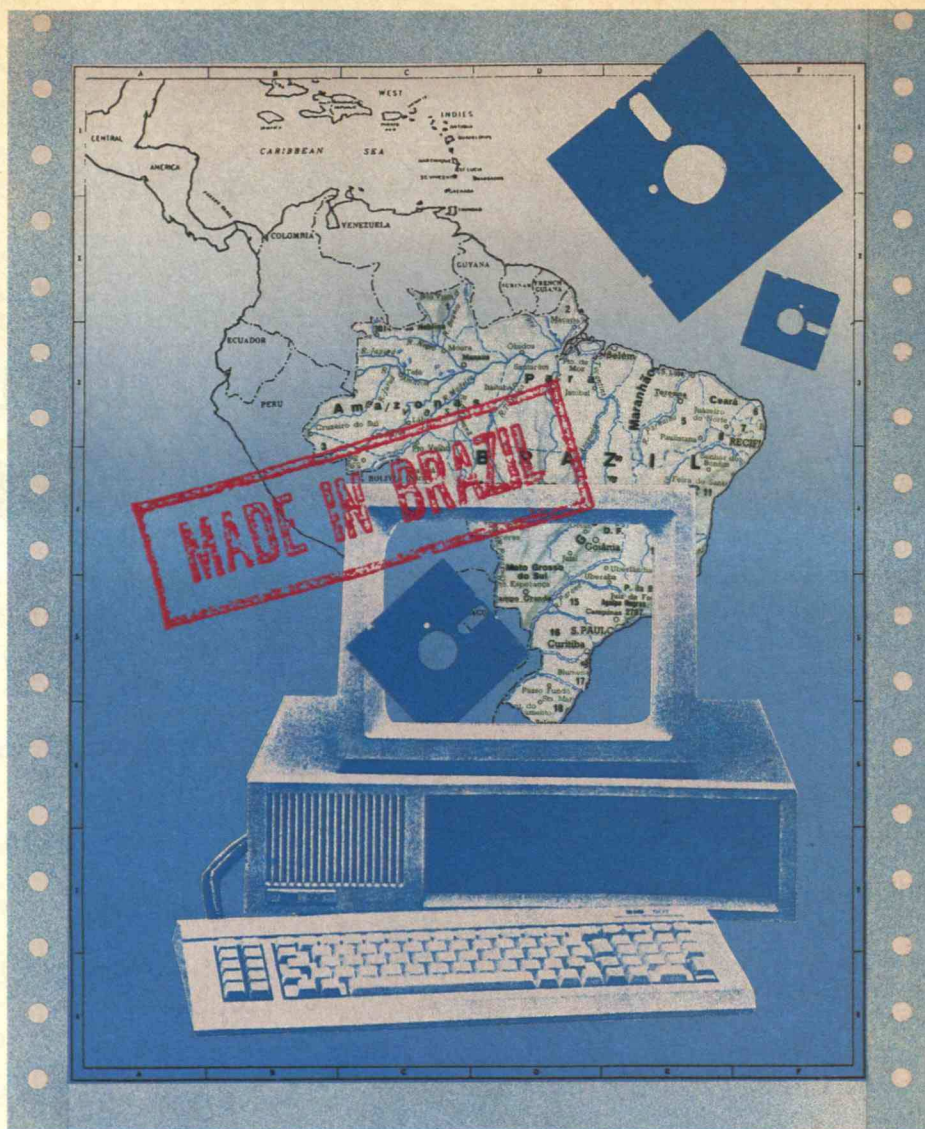
Letter, marked copy, & ten extra copies to author.



BY ANTONIO JOSÉ J. BOTELHO

In 1975

Brazilian-controlled firms produced only 5 percent of the computers in that country. By 1986 they accounted for over 75 percent.



ernment accepted an IBM proposal to expand its Mexican operations and construct a 100 percent IBM-owned plant to manufacture PCs. IBM will establish a semiconductor development center for Mexican industry, purchase a variety of high-tech products from Mexican companies, and produce software for Latin America in Mexico.

India has taken a somewhat different line, seeking to expand exports, particularly of peripherals and software, and also to boost the domestic use of large computers. Like Brazil, India has a fast-growing—potentially one of the world's largest—computer markets.

India subjects computers valued under about \$10,000 to heavy import duties to protect its microcomputer industry. The duties will gradually be phased out as the Indian industry becomes more competitive. Low duties on imported parts and com-

ponents for producing peripherals aim to develop a peripherals industry capable of rapidly gaining international competitiveness.

The manufacture of mainframes and superminis is restricted to government-owned firms, while tax and R&D incentives assist India's private hardware and software industries. However, 30 computer models valued at over \$10,000 can be imported with lower duties. These allowed imports are intended to ensure that India will get the latest technology. For example, IBM mainframe computers have been authorized for use in oil and natural-gas exploration and railway reservation systems. Included in the list are models produced by companies that have service offices in India and show potential for producing equipment in partnership with Indian companies. This selective list of larger computers also encourages software development for a few standard systems. One of India's goals is to produce \$100 million worth of software annually over the next five years. Software exports have been growing by 40 percent a year.

ANTONIO JOSÉ J. BOTELHO is co-editor of *The Computer Question in Brazil: High Technology in a Developing Society*. He is a doctoral candidate in political science at M.I.T. His dissertation compares the Brazilian and French computer and microelectronics industries.

South Korea, a success story among the newly industrializing countries of Southeast Asia, has a computer policy that reflects the export strategy it has pursued for the past two decades. The country's computer policy is built around three or four major conglomerates with significant experience in manufacturing and exporting televisions and other consumer electronic products. Korea seeks to help these conglomerates acquire a similar export edge in low-end microcomputers and semiconductors.

Toward this end the government has an extremely selective policy of acquiring technology, and has prodded firms to establish joint ventures with foreign computer companies to learn their technology. This strategy has paid off handsomely. Korean firms have penetrated the low-end professional microcomputer market in the United States. Only recently, with declining export sales, has the Korean computer industry expanded into the domestic market.

While India, Korea, and, to a lesser extent, Mexico focus on exports, Brazil's policy aims primarily to foster Brazilian-owned firms that will serve a domestic computer market. The basic principles of this policy, laid out in the early seventies, were institutionalized in the National Informatics Law approved in November 1984. Informatics is the word used in Brazil to cover the whole field of computing, including microelectronics, automation, software, and peripheral equipment. The National Informatics Law reserves the market for microcomputers, minicomputers, and peripherals for Brazilian "national" companies. It defines a national company as one with 70 percent Brazilian ownership, and Brazilians must control management and technological decisions. At the end of 1985 Congress enacted the first National Informatics Plan (PLANIN), which created mechanisms designed to promote the industry. The "market-reserve policy" will last until 1992, when Brazilian firms are expected to be internationally competitive.

The Roots of Brazil's Informatics Policy

The origins of the National Informatics Law lie in the so-called "Brazilian miracle." This process of economic development, begun in the late sixties, was characterized by gigantic government projects—such as the Trans Amazonic Highway—and by the modernization of the consumer durables industry. This effort demanded more than imported technology.

Thousands of students were sent abroad for graduate study. Public support for university research and graduate training increased rapidly, and major state-owned companies established R&D labs.

Another early step toward the 1984 law was an unsuccessful attempt in the early seventies to develop a minicomputer industry through joint ventures with non-Brazilian firms. Foreign companies were supposed to supply the technology, while the state and the Brazilian private sector would supply capital and marketing experience. However, all major U.S. computer manufacturers refused to make deals, since Brazil's Technology Transfer and Intellectual Property Code restricted their royalties and the length of contracts. In 1973, after extensive international negotiations, the British firm Ferranti and the Japanese firm Fujitsu did agree to participate. But only the Ferranti joint venture, Cobra, became a reality, and it was plagued by financial and managerial problems and poor product decisions, in part because the partners were unable to agree on major issues. Cobra did not sell its first Ferranti-based industrial minicomputer until late 1976.

Meanwhile the Brazilian data-processing market grew rapidly in the early seventies (30 percent a year versus 20 percent for the world market). The Brazilian government accounted for a fifth of such purchases, prompting it to establish the Commission for the Coordination of Electronic Activities (CAPRE) in 1972. CAPRE's general mission was to coordinate federal data-processing activities and purchases.

After the first oil crisis drained Brazil's foreign exchange, CAPRE in 1976 imposed import quotas on data-processing equipment—by then the third largest import. At the same time, policy struggles in Brazil had led to the abandonment of the joint-venture strategy. With the backing of the powerful National Bank for Economic Development (BNDE) and a large segment of the academic community, CAPRE began to promote licensing agreements between domestic and foreign firms.

Finally, CAPRE began preparing an overall policy to develop a broad Brazilian computer industry. In June 1976 the agency recommended that "when feasible, mini- and microcomputers and peripheral devices be reserved for the domestic industry"—thus beginning the market-reserve policy later embodied in the National Informatics Law.

A challenge to the policy came quickly. When Brazil first decided to protect the minicomputer and



THE BRAZILIAN COMPUTER INDUSTRY

MARKET	FIRMS
Mainframes	IBM (U.S.), Burroughs (U.S.), ABC Telematica (Honeywell Bull, France Grupo ABC, Brazil), Moddata (Control Data)
Middle-sized computers	Cobra, Novodata, Sisco
Superminis	ABC Dados, Cobra, Edisa, Elebra Computadores, Itaotec, Sisco
Minicomputers	Cobra, Edisa, Labo, Novodata, Medidata, Sisco, SID
Microcomputers (includes data-entry systems)	Appletronica, Auto-Data, Basic, CCE, Digibyte, Diginet, Digirede, Digitus, Dismac, Elogica, Logus, Magnex, Itaotec, Microtec, Maquis, Microdigital, Micro/Servo, Polymax, Prologica, Quartzil, Scopus, Softec, Spectrum, Splice, Unitron, Victor
Scientific Comps	Hewlett-Packard
Peripherals	Conpart, EBC, Elebra Informatica, Elgin, Expansao, Scritta, Digilab, CMA, TDA, Telematica, Videotek, Flexidisk, Multidigit, Percomp, Perifericos, Microlab
Other equipment (modems, special terminals, concentrators)	ABC Dados, Electrodigi, Eletrotela, Racimec, Gepeto, Elebra Telecon, Zanthus, Moddata, Coencisa, Digitel, Parks, Rhede, Tropical, PGM, STI, Stratus, Cetus, Digiponto, Logodata, MDA, Mecaf, Menno, Metalma

microcomputer markets, no foreign firms manufactured or assembled such equipment in the country. IBM of Brazil assembled some mainframes and peripherals, mostly for export. However, a few months later IBM announced it would start manufacturing its small business minicomputer, the System/32, in Brazil, apparently to undercut the domestic market being developed in minicomputers. Associations of computer professionals, backed by CAPRE, protested, charging that IBM's plans threatened the development of a national minicomputer industry since IBM would retain control of the operation.

IBM shelved its plans in January 1977 after the Council of Economic Development (CDE), Brazil's highest body for economic policy, announced criteria for approving new computer industry projects. The criteria aimed to increase the amount of technology transferred to Brazilian engineers, the degree to which Brazilian firms produced the equipment, and the share of the company's equity that Brazilian stockholders controlled. The CDE also announced that it would look favorably upon projects that improved Brazil's international balance of payments.

CAPRE selected three Brazilian firms to manufacture minicomputers by licensing foreign technology.

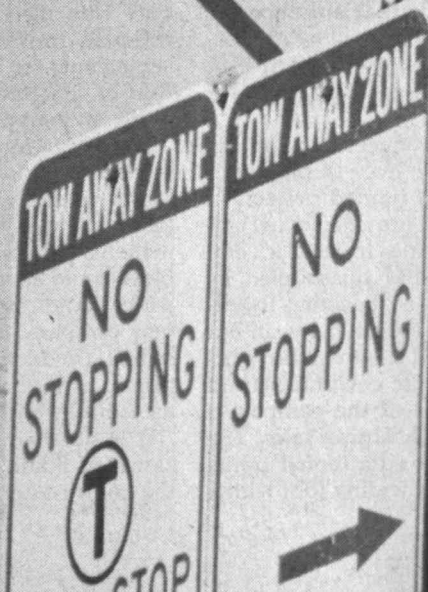
A 1975 act limited the licensing period to five years and royalty payments to 5 percent of net sales, and did not allow the license to be renewed. The three Brazilian firms eventually produced minicomputers with technology licensed from French, German, and Japanese manufacturers.

In 1979 the Special Secretariat of Informatics (SEI), under the National Security Council rather than civilian control, took over CAPRE's responsibilities but basically reaffirmed its policies. SEI restricted imports of minicomputers for an additional three years and applied the policy to microcomputers and a variety of peripheral equipment. SEI also restricted imports of most software, digital instrumentation, and superminis.

The Brazilian microcomputer industry actually required little assist. The simple design of microcomputers and the wide availability of microprocessors allowed domestic firms to clone equipment such as the Tandy TRS-80, Apple II, and IBM-PC. By contrast, Brazilian minicomputer manufacturers faced difficult times by 1984, suffering from competition from IBM 4341s—the smallest mainframe IBM produced in Brazil. Production of Brazilian minicomputers declined about 30 percent between 1982 and

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ABOUT THE COVER

It is often the top contender for the most light-hearted page in Technology Review. But this cover of the MIT section outdoes itself for tongue in cheek. This sign, posted at 77 Mass Avenue, was a witty but unstrutuous hack. Photo by David M. Watson, '88, from *The Tech*.

FOR THE RECORD

BY JAMES M. LEAS, '68

*Mashed copy + Letter sent to author
5/15*

IBM Pulls Out of South Africa—Or Does It?

In announcing the sale of its South African capital assets as of March 1, 1987, IBM appeared to be dealing a blow to apartheid. The company, whose sales were a hefty half percent of South Africa's GNP, will no longer visibly legitimize South Africa's system of racial oppression. IBM claims that relinquishing ownership of its South African subsidiary is the full departure demanded by the divestment and disinvestment movements in the United States.

But the gesture is little more than symbolic—shipments of IBM products to South Africa will continue unabated.

The official withdrawal of IBM signals the failure of the company's previously advertised efforts to "work actively for change" and provide a "model" for equality in South Africa. Like other high-tech companies operating in South Africa, IBM harshly criticized apartheid and portrayed itself as supporting the political demands of the black majority. IBM's operations in the country, however, were limited to sales, and all of its customers were white. That was not by choice—IBM would happily have sold computers to blacks. But the economic affects of apartheid keep blacks out of the computer market.

The sale of computers may not be intentionally unfair or purposely supportive of apartheid. But the computers IBM has been selling in South Africa are high-leverage tools that enhance the power of the white minority by improving industrial and government efficiency and diminishing reliance on black labor.

Aware that its products were not directly benefiting the lives of the South African blacks, IBM funded projects in black education and provided equal employment opportunities for its black employees. In 1985, IBM quadrupled its "work for change" by boosting its education grants to \$4 million per year. But even this fund is still less than IBM's tax payments to the white government and less than 2 percent of the company's \$250 million in South African sales. The primary value of the educational grants appeared to be in providing IBM with a

positive response to persistent questions about its business activity in South Africa.

IBM is not alone in showcasing such programs. Spokespersons for most leading high-tech companies still operating in South Africa speak emphatically about their support for black education and avoid the question of whether their sales of technology to virtually all-white customers help to perpetuate white domination. If technology sales to South Africa were cut, it is the white customers who would suffer, not the blacks.

Customers Not Abandoned

IBM has assured its South African customers that they are not being abandoned. IBM equipment will continue to flow into South Africa through a new company owned by former IBM employees. Jack Clark, president of IBM South Africa and president of the new entity, Information Services Management Ltd., said that there will be no change in product or service availability. (IBM did no manufacturing in South Africa.) From the customers' point of view, IBM's departure means little more than a change in the name on the sales office door.

IBM does have a model for a more clear-cut corporate withdrawal: In 1977, when it pulled out of India after a dispute with the Indian government, the company provided generous severance settlements for its employees and then totally discontinued sales, service, parts, and supplies.

In South Africa, IBM says that its goal in continuing sales is to maintain jobs for its former employees. But that really sidesteps two questions: Why were settlements adequate for its Indian employees not adequate for those in South Africa? And doesn't the freedom of the new company to ensure its survival by selling products from other manufacturers, as well as IBM, make that argument irrelevant?

It is possible that after IBM's capital assets in South Africa are transferred, the controversy surrounding its activi-

*Mashed copy
to his home address as shown in Student Directory*



ties there will subside, and sales could actually improve.

It is just as possible, however, that the controversy will continue. The IBM departure scheme has been called a "sham," "sleight of hand," and a "shell game" in some media reports.

In either case, the IBM experience does seem to bear out what other corporate representatives have said for some time about the impact of disinvestment in South Africa. Beyond its symbolic value, they said, the departure of American companies will create only a small benefit for the oppressed South African blacks, will put little pressure on the South African government to end apartheid, and will diminish the corporate leverage for change—since such

companies will no longer have a forum in which to speak out against the system.

The only way for IBM to remove the shadow that hangs over its actions in South Africa, to prove that its departure was not merely symbolic and self-serving, and to genuinely undermine apartheid would be to take the final step. The best interest of the company, the black majority, and South Africa as a whole would be served by a decision to stop altogether IBM shipments to its white South African customers. □

JAMES M. LEAS, '68, is an electronics engineer at IBM in Manassas, Va. The views expressed in this article are his own.

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Race Relations on Campus: the Problem, Some Solutions

By Susan Lewis

MI.T. is not known as a fun place for anybody to go to school. Getting through is tough. "But if you are a student and I am a student, you have one problem and I have two," says Clarence Williams. "I am also black."

Williams is M.I.T.'s assistant equal opportunity officer, and his conviction that racism is an additional burden faced by minority students at M.I.T. is corroborated by a report that stunned the Institute community when it was released in October 1986.

The document, titled *The Racial Climate on the M.I.T. Campus: A Report of the Minority Student Issues Group (MSIG)*, was two years in the making.

It showed that for underrepresented minorities (blacks, Native Americans, and Hispanics), "the environment for living and learning at M.I.T. poses special problems," in the words of President Paul E. Gray, '54.

The report was based on the first of several studies designed to help M.I.T. understand why the achievements of black students do not measure up to the potential they showed in high school.

For example, while 85 percent of all white students admitted to M.I.T. graduate within six years, only 75 percent of the black students do so.

The campus has been working for the last six months to come to grips with the implications of this first report.

The report's conclusions about the campus are based on a series of 75-minute, opened-ended telephone interviews, conducted by trained interviewers, with 42 women and 95 men among the 671 black students who attended M.I.T. between 1969 and 1985.

Blacks make up the only underrepresented minority group that has attended M.I.T. in sufficient numbers to provide statistically useful information.

When the data were evaluated, the responses of recently graduated alumni were given the most weight.

The study showed that some 20 percent of the black alumni experienced racist attitudes or actions that undermined their confidence, left them socially iso-



lated, and discouraged them from seeking academic help from faculty and teaching assistants (TAs) or working cooperatively with white students.

Alumni reported blatantly racist remarks: One student who went to a professor to talk about a grade was told, "Maybe you people should go somewhere and do things that you people can do." Blacks won't do well in mathematics because they lack spatial sense,

was the faculty comment to another black student.

In other cases, professors who believed that their intentions were humane sent out all the wrong messages: They avoided calling on blacks in class or asked them only embarrassingly easy questions. At least one faculty member reported that he did not suggest that an otherwise able black student withdraw from a class in which she was obviously

***"Race-related
and faculty-related
difficulties were typically central
to the black experience
at M.I.T."***



having difficulty; he was afraid his appraisal of the student's ability in this one subject would be taken as a racially motivated comment on her overall competence.

Neglect Is Not Benign

Of some eight members of the Black Alumni of M.I.T. (BAMIT) with whom I happened to have lunch at a confer-

ence in the fall, not one could report a supportive relationship with any faculty member at M.I.T.

Although several of my lunch companions were graduate students, not one had received encouragement from a professor to attend graduate school. Nor did they receive, they said, the personal references and the guidance in selecting reading lists, research projects, and thesis topics—those benefits usually referred to as mentoring—that they saw paving the way for white students who wanted to pursue graduate degrees.

Although faculty-student issues were of primary concern, alumni did report being the butt of racist remarks in the residences.

In summarizing the comments of the black alumni, the authors of the report remarked that "race-related and faculty-related difficulties were typically central to the black experience at M.I.T."

Clearly, change is required.

The first step was publishing the report. "You do not address problems unless you know they exist," Constantine Simonides, '57, says, "and knowing involves talking about them." He was outlining the rationale behind the administration's decision to publicize the document. Simonides is M.I.T. vice-president and equal opportunity officer, as well as secretary of the Corporation.

The decision to release the report was itself regarded by many on campus as a courageous one, because no one needed to be told how quickly the outside media would jump on M.I.T.'s candid admission of difficulties faced by its minority students. In fact, the administration anticipated media interest by issuing a press release when the report was distributed on campus.

Reaction was swift: "Blacks at M.I.T. face bias, little support," said the headline in the *Boston Globe*. "Study Finds Racism at M.I.T.," appeared over the story in the *New York Times*.

Even months later in the *Wall Street Journal*, a stack of headlines over a page-one article on racism on American campuses included the line "A Junior at

M.I.T.: 'I'm Alone.' "

The report faced a mixed reception on campus as well. In private comments, letters to *The Tech*, and the like, faculty and students often expressed disbelief, saying that loss of confidence and isolation are common experiences of M.I.T. students of all races.

But in his address to faculty on the report and in every other forum, the president has detailed his support of the report and his voiced conviction that the situation it outlines is "shocking and out of place at M.I.T."

Candor at a Cost?

The report came at the time of year when high school seniors and their parents were deciding which colleges they would apply to. The headlines seemed to suggest not that M.I.T. is more forthright in discussing its problems, but that M.I.T. is host to more serious racial problems than other institutions. Would the publicity discourage qualified minority students from applying?

"We were concerned about the impact on the marketplace," Simonides says frankly.

Relief was followed by elation as first the applications for early admission and then those for regular admission to the Class of '91 showed minority applications not only holding strong but climbing a dramatic 38 percent.

What's Happening in the Trenches?

Dean for Student Affairs Shirley McBay, who chairs the MSIG, was quoted in the *Boston Globe* as saying that "the report is one indicator that M.I.T. has the will and capacity for effective change." In a series of conversations around the Institute, I encountered activities and ideas that left me equally optimistic.

A few points are worth mentioning at the outset. First, the problems that emerge from the study center around the personal interactions; the solutions are to be implemented at the "local" level—in each school, department, and classroom. These solutions are backed

up by vigorous policies at the very top levels of the administration.

Second, although it is tempting to suggest similarities between the struggles of women and of minorities for educational and career opportunities in technical fields, the members of BAMIT with whom I spoke see the situations as quite different.

Women, although underrepresented in science and engineering disciplines, are more than 50 percent of the general population—every male has women in his usual environment.

Blacks, on the other hand, make up only 12 percent of the population of the United States, Hispanics some 7 percent, and Native Americans only less than 1 percent. For many white students, their first encounter with a black or Hispanic is in college; minority alumni reported frequent comments to that effect.

Thus there is a wide gap in experience and understanding between many white and minority students, and because the numbers of minorities are likely to remain relatively small, the gap will be more difficult to bridge.

First Goal: More Minority Faculty

There is widespread agreement that the hiring of more minority faculty is vital if M.I.T. is to optimize the academic achievement of minority students. The importance of minority faculty as role models and advisors cannot be overemphasized, and many minority alumni reported that their only positive faculty relationship was with a minority faculty member.

Provost John Deutch, '61, has made it clear that one of the standards on which academic administrators will be evaluated is their success in hiring more minority (and women) faculty.

But as President Gray has pointed out, the pool of minority faculty candidates is very small. The percentage of Ph.D.s in mathematics, the sciences, and engineering awarded to blacks at American universities has increased only marginally, from less than 1 percent in



One of the standards on which academic administrators will be evaluated is their hiring of more minority faculty.

the 1960s to 1.5 percent in 1985, the last year for which figures are available.

M.I.T. should meet this shortage of Ph.D.s by working on the supply end, say Shirley McBay and others. She recommends the appointment of a staff member in each school whose responsibility would be to recruit minority graduate students.

McBay's suggestion has already been tested. The addition of a part-time graduate student recruitment officer in the Department of Urban Studies and Planning was one of the factors that helped to quadruple the number of minority applicants for the master's program in city planning, according to Dean of Architecture and Planning John de Monchaux.

Clarence Williams suggests that more efforts be made to introduce minority undergraduates to research in hopes of motivating them to pursue advanced degrees. The M.I.T. Graduate School al-

ready operates a program that allows students from historically black colleges to participate in research in Institute laboratories for the summer. Indeed, it was this program that first brought the late astronaut Ronald McNair, Ph.D.'77, to M.I.T.

While recruiting minority graduate students may serve the long-term faculty requirements of American universities, Williams says, it can also help nurture talent the country cannot afford to lose. Williams quotes an unpublished study that shows that fewer than 1 percent of the pre-college black children who show a potential for careers in math, engineering, and science go on to earn a doctorate; most end their formal educations with high school diplomas or bachelor's degrees.

Boston's Reputation Doesn't Help

The city of Boston is not known for being hospitable to blacks, and Williams says that does not make it easy for M.I.T. to recruit black faculty. Unlike such cities as Los Angeles, Washington, Atlanta, and Chicago, Boston has not elected blacks to citywide positions of leadership, and only 2 of the 100 top black-owned businesses in the United States are based in Boston. The public school desegregation problem has also brought Boston unfortunate national news coverage. All these things, Williams says, tell blacks something about the climate they could face here.

Difficult as it is, hiring is only half the battle, Williams says. Too many minority faculty have left M.I.T. in the last few years, and he believes that the situation could be improved by special efforts to structure minority faculty into the mainstream of a department, beginning even before they are hired.

Mentors and role models for minority faculty must be identified, says Williams. If such relationships cannot be built within a department, they must be found elsewhere.

For example, he says, if you hire a black woman in a department that has no other black faculty members, a black

woman could be identified elsewhere at the Institute, at another Boston university, or perhaps in local industry who could serve as a resource person for the newcomer.

Williams says that new minority faculty not only need fellow minority members to serve as models and sounding boards, they need senior members of their own departments who can help them find research support and other forms of academic back-up. Without that latter form of help, he emphasizes, no new faculty member would be likely to develop the potential for which he or she was hired.

For all that, Williams, who has been an administrator in several areas of the Institute since 1972, is convinced that M.I.T. is on the right track in its minority relations. He characterizes the M.I.T. approach as: "Let's deal first with ideas instead of what it costs [to implement ideas]," adding, "That's why I enjoy being here."

School of Engineering Shocked

The instances of overt racism described in the MSIG report came as a "shock" to the School of Engineering, says Donna Savicki, assistant dean for administration. Dean Gerald Wilson, '61, and the engineering department heads have taken the report very seriously, Savicki says.

"The dean felt that the strength of the report was in its anecdotal, personal evidence," she says. "But he wanted to ensure that the school responded in ways that elicited positive steps, not confrontation."

The school council held several meetings with McBay and other members of the MSIG. At those sessions, Savicki reports, there was widespread agreement on the importance of consciousness-raising—the need for faculty and other staff members to become more sensitive to the implications of their actions—regardless of their intent.

Department heads were charged with generating discussion of the report and with informing the Dean's Office of the



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specific steps their departments decide to take to improve the climate for minority students.

Each engineering department has held a meeting to discuss the report, and copies were circulated to teaching assistants in a number of departments as part of their training packages.

Several departments are planning to appoint an ombudsperson to handle minority concerns. And some are planning to convene special meetings of all the faculty teaching undergraduate subjects to discuss specific measures to support minority students.

Black graduate students in chemical engineering helped the department recruit minority undergraduates—reading application folders and making phone calls to admitted minority students, urging them to come to M.I.T.

Improving its support for minority undergraduates will be much easier than making any significant change in

the number of minority faculty in the School of Engineering, Savicki says.

For more than four years, the dean has offered to create additional departmental positions for qualified minority (and women) faculty members whose academic specialties do not precisely match current departmental needs. But the school has only been able to recruit three women and one black under that program.

Financial support is also available from the dean of engineering for post-doctoral fellowships for women and minorities who have faculty potential, and the school is trying to increase the opportunities for visiting black and women faculty to come to M.I.T. to conduct research and teach.

Ethnic Studies Program a Possibility

Douglas Pfeiffer, assistant dean for finance and administration in the School of Humanities and Social Science (SHSS), is the officer overseeing the school's response to the MSIG report. After meetings of the dean plus the department and section heads with McBay and other members of MSIG and meetings within each SHSS department, section, or program, Pfeiffer says, it was decided that each SHSS unit will appoint a minority student officer.

The officer, who will be a member of the faculty, will convene regular meetings of minority students and faculty members and otherwise help to optimize the learning environment for minority students.

SHSS Dean Ann F. Friedlaender, Ph.D. '64, is also assembling a working group to consider a degree program in ethnic studies. Such a program, if offered, would be based on subjects and faculty expertise already available in the school organized into a meaningful course of study, the dean says.

As in the case of Women's Studies at M.I.T., an ethnic studies program could serve more than a specific academic function: It could be a campus-wide center for activities and resources focusing on the contributions of various ethnic

groups to human experience and heightening sensitivity to ethnic issues.

In the interest of hiring minority faculty, each SHSS unit head is preparing a "target of opportunity" list, Pfeiffer says. The process entails several steps:

- ☐ Contacting academic departments nationwide for the names of recent or upcoming minority recipients of graduate degrees
- ☐ Assembling a list of more senior minority faculty members at other institution
- ☐ Reviewing all these candidates and contacting those who have the most to offer M.I.T.
- ☐ Presenting to the administration the names of one or more candidates for a faculty job offer.

The work of Department of Linguistics and Philosophy Chairman Richard Cartwright in recruiting one of the department's new assistant professors—Michael O. Hardimon—is an example of the search procedure in action. Cartwright personally made some 80 phone calls around the country to locate several minority candidates before ultimately offering a job to Hardimon.

Long-term Commitment in Architecture and Planning

The School of Architecture and Planning has a 20-year history of concern with racial issues, reports John de Monchaux, and publication of the report on the racial climate only strengthened its commitment.

The dean notes that the report was based on interviews with undergraduate alumni, while some three-quarters of the students in architecture and planning are graduate students. But he is operating on the assumption that if M.I.T. were to survey its minority graduate alumni (a step he recommends), the experiences reported would be much the same.

Already in place in the school are regular meetings between minority students and two minority members of the faculty, Frank Jones and Mel King, to air



*Special efforts
in Architecture and
Planning quadrupled the
applications for
graduate study
at MIT.*

concerns. And when he welcomes new students at the start of the year, the dean has made a point of identifying members of the M.I.T. community whose role is to help with problems of discrimination.

De Monchaux says there is a lot of anecdotal evidence that the cost of an M.I.T. degree prevents minority students from even applying here. As of spring 1986, for example, fewer than 10 minority students had applied for fall admission to M.I.T.'s graduate program in planning.

This year, the Graduate School made an advance commitment to fund 12 graduate fellowships for minority candidates for the master's degree in planning. This commitment, together with the efforts of the half-time recruitment officer mentioned earlier, resulted in at

least 45 minority applicants to the Department of Urban Studies and Planning as of February '87. This increase came at a time when there is a decline in the number of minority students going into planning nationwide.

(M.I.T. has graduated more minority planners than any school but Howard University, a traditionally black institution.)

The School of Architecture and Planning launched a wide search between April and November 1986, resulting in the hiring of three new faculty members—one minority, one woman, and one white male.

The dean says that as faculty members travel now on other business, they are making special efforts to meet minority students and potential minority faculty members. They often ask their host departments for an opportunity to meet with minority students as a group.

Student Affairs Dean

The months since the report was published have been heavy with meetings for Dean for Student Affairs McBay.

She has found that faculty members accustomed to dealing with subtle psychological and leadership issues in their subject areas tend to be the most sensitive to racial problems.

But faculty who deal with quantitative data often try to apply their usual standards of evidence to questions of race. That can be frustrating for them, McBay says. We cannot quantify *how* seriously a student's confidence has been damaged by a racist remark. Nor can we measure precisely the effect of such a remark on his or her performance.

McBay says that a number of useful ideas have come out of the discussions, several of which have been or are expected to be implemented:

- ☐ Faculty-student discussions of racial issues;
- ☐ The appointment of ombudspersons
- ☐ Statements by faculty in their opening classes expressing support for the report and their determination to re-

spond to the needs of minority students

- A discussion of the report with all new faculty, TAs, residence tutors, and other new employees of the Institute
- And a new brochure addressing the question of racism on campus and alerting students to their options in dealing with racism.

The faculty held a "teach-in" on March 4, in which members of the M.I.T. community were invited to participate in some 17 classes dealing with historical and contemporary questions of race and ethnicity.

The grievance procedure in cases of racial discrimination is expected to be clarified, McBay says, to make it as straightforward as the Institute procedures for dealing with sexual harassment.

M.I.T. Taking the Lead

An article on the problems of black students on predominantly white campuses that appeared in the *Wall Street Journal* on April 3 was the most recent evidence that M.I.T.'s decision to publish its report on the racial climate is having reverberations nationwide. Reporters are now quizzing administrators from other institutions, and M.I.T. has received calls from other universities and colleges, McBay says, asking how the Institute organized both the study and its response.

One on One Makes a Difference

For several years the president and the provost have maintained a commitment—similar to the policy in engineering—to make funds available for short-term appointments for highly qualified minority candidates, even if their particular areas of expertise are not those most urgently required by the department in which they are hired.

But recently that commitment was strengthened to allow departments to create open-ended appointments for new minority faculty, according to Institute Professor of Physics Herman



*"We have to
sell the idea that
every minority college
student is a precious
commodity, because
at the moment we
have so few."*

Feshbach, Ph.D.'42, chairman of the Faculty Committee on Equal Opportunity.

The committee oversees all hiring policies at the Institute. Alarmed by the decline in the number of black faculty in recent years, however, the committee is concentrating on faculty hiring of underrepresented minorities.

Over the past 18 months, Feshbach has been slowly making the rounds of department and program heads, discussing the possibility of intensified searches for minority faculty. He is urging the departments to cast their nets widely, to consider not merely a small subset of their fields.

There is no question that exhaustive searches are time-consuming, Feshbach says, estimating about one-quarter release time for a faculty member for one

year. And such searches must be led by senior faculty who have the contacts in their fields, he says.

What Feshbach is now able to offer, backed up by special funds from the Provost's Office, is administrative support, such as extra secretarial services for faculty members who take on the search responsibilities.

Of the six departments Feshbach has visited so far, all have appointed or are about to appoint search officers, and one, mathematics, has already brought a black woman visiting professor Iris Mack to M.I.T. from Harvard.

Feshbach was delighted with a report from Carol Morris, '87, president of the Black Students' Union: Morris says she knows of black students who sat in on Mack's classes just to have the exhilarating experience of having a class at M.I.T. led by a black woman.

"I hadn't heard that," Feshbach said, with some feeling. "That makes it all worthwhile."

Feshbach also wants to look into the reasons black faculty have left M.I.T. over the past decade. "There is a concern that some care must be taken with minority faculty," he says, echoing the point made by Clarence Williams.

A Process, Not a Master Plan

"We need a mosaic of solutions," Shirley McBay says, underscoring the lessons learned in her, and my own, conversations around the Institute.

She also emphasizes the importance of engaging in a process of combating racism, rather than developing a master plan for doing so. "People can buy into a process, if they have time to become informed," she says. "But the natural tendency with a master plan is to critique it—find the plan's flaws—rather than come up with one's own constructive ideas."

Concluded McBay:

"We have to sell the idea that every minority college student is a precious commodity, because at the moment we have so few." □

Commencement Speaker, New Dean, and Travelling Art

Olsen To Speak at Commencement

Kenneth H. Olsen, '50, the founding president of Digital Equipment Corp., will be principal speaker at Commencement on June 1.

His audience will include over 1,700 graduates, as well as many of Olsen's colleagues on the M.I.T. Corporation, members of the 50-year Class of 1937, faculty, and at least 6,000 parents, friends, and guests of those receiving degrees.

Barring unfavorable weather, the Graduation Exercises will be held in Kilian Court, beginning at 10 a.m. But after last year's traumatic rain, the Commencement Committee is this year paying unusual attention to contingency plans. They include simultaneous presentations in Rockwell Cage, the Athletic Center, and Kresge Auditorium, with remote viewing in many Institute classrooms.

Olsen entered M.I.T. from Bridge-

port, Conn., after Navy service in World War II. He continued in electrical engineering after receiving his bachelor's degree, earning a master's degree in 1952 while a member of the staff of the Digital Computer Laboratory. It was here that he participated in design and construction of two high-performance, transistorized digital computers, TX-0 and TX-2. And it was these two machines that provided the foundation of Digital Equipment Corp., an M.I.T. spin-off that Olsen launched when he left the Institute in 1957.

Since then the success of Olsen's company has earned him *Fortune* magazine's accolade of "... arguably the most successful entrepreneur in the history of American business." With \$7.6 billion annual revenues, Olsen's company is larger today, even adjusting for inflation, than was Ford at the time of Henry Ford's death, U.S. Steel when Andrew Carnegie sold his interest in it, and Standard Oil when John D. Rockefeller stepped aside, according to *Fortune's* analysis. □

Thurow New Dean for Sloan School

Its best-known faculty member, economist Lester C. Thurow, will become dean of the Sloan School of Management next July 1.

Announcing the appointment, President Paul E. Gray, '54, and Provost John M. Deutch, '61, said they were "particularly struck by [Thurow's] vision of the special challenges and opportunities facing the management school in a university centered on science and technology." For Gordon McKibbin of the *Boston Globe*, Thurow added some specifics: "A big part of our competitive problems stem from top management that doesn't understand the technology they are supposed to manage," he said. "Somehow we need to give managers without formal training in science and engineering an understanding, a competence, in technology."

Thurow is widely known for his pop-

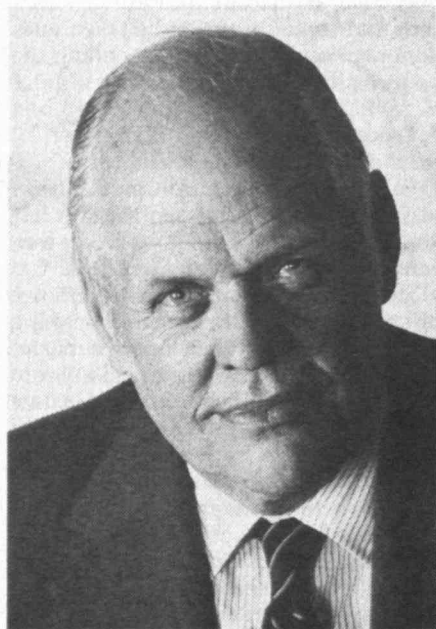


L. C. Thurow

ular as well as scholarly writing and commentary about economic and managerial problems. He describes himself as an "economics educator," and he says his writing and speaking activities will continue. He is the author, co-author, or editor of 13 books—including the best-selling *The Zero-Sum Society* (1980) and *The Zero-Sum Solution: Building a World-Class American Economy* (1985). He's also a member of the Editorial Board of the *New York Times* and of the *Time Magazine* Board of Economists; and he writes regularly for the *Times*, the *Boston Globe*, the *Los Angeles Times*, and *Technology Review*.

He replaces Abraham J. Siegel, who will step down after 20 years in the dean's office to return to full-time teaching and research.

The appointment was greeted warmly by Thurow's colleagues and peers. "A great choice," said David Bloom, of Brecker and Merryman, a New York consulting firm. "You start with a quality school and add to it a man with pizzazz and economic aplomb and who's



K. H. Olsen

slightly controversial, and the Sloan School comes out well positioned for the future."

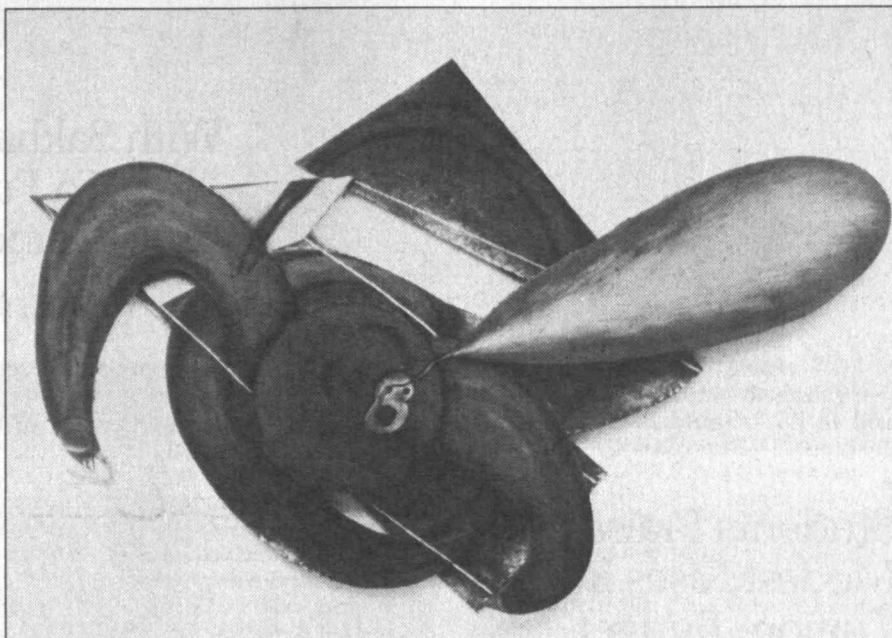
"Marvelous," said Robert Reich, professor of public policy at Harvard. "What it implies is that many of the themes [Thurow] has worked on, like competitiveness and productivity, are coming into the mainstream, that they are important considerations for managers to understand and learn."

Thurow was born in Livingston, Montana, in 1938. He won a Rhodes Scholarship while studying at Williams College in 1960 and came back from Oxford to receive a Ph.D. in economics at Harvard in 1964. At M.I.T. since 1968, Thurow holds a joint faculty appointment in the Sloan School and Department of Economics. □

M.I.T.-Organized Tour Takes Art Coast to Coast

At 13, painter Elizabeth Murray wanted to be a cartoonist, and her brightly colored abstract images owe as much to Walt Disney as to her other heroes, Cezanne, da Vinci, and de Kooning. Her paintings feature familiar images and symbols such as punctuation marks (she is particularly fond of the shape of the comma and question mark), goblets, cups and saucers, and artists' materials such as palettes and paintbrushes. Depending on the viewer's perspective, these items can seem either mundane or surreal, or may simply function as unremarked-upon abstract shapes.

Yet Murray's reputation as one of the most important painters of her generation rests on the manner in which she bridges painting and sculpture, and how she builds three-dimensionality—or its illusion—into her work. Her canvases often overlap or seem to burst apart like flying shrapnel. Underscoring the realization that the painting is itself an object, she frames spaces where the wall can be seen through the picture. As



Painter Elizabeth Murray says she was thinking about Norwegian artist Edvard Munch when she created this oil on canvas, titled "Can You Hear Me?" It is part of the travelling exhibit of her work M.I.T. helped organize.

she has told a number of interviewers, she starts every painting as a kind of glorified, emotion-laden jigsaw puzzle.

Alumni in several U.S. cities will have the opportunity to form their own reactions to Murray's work, thanks to a travelling exhibit organized by the List Visual Arts Center at M.I.T. and the Dallas Museum of Art.

Kathy Halbreich was the director of the List Center when she arranged to collaborate with Sue Graze, curator of contemporary art at the Dallas Museum of Art, on a major retrospective covering the last decade of Murray's painting. Now an independent curator and writer in the Boston area, Halbreich is unequivocal in her praise for Murray: "Elizabeth is one of the great artists of our time. Period."

"What's extraordinary in her work is that Elizabeth makes visible the intellectual and emotional impulses for making art, and by extension, making sense out of life," Halbreich explains. "Elizabeth would call herself an abstract artist, but the work also has a yearning for domestic order, perhaps for more certainty than might be possible in the lives we lead. It is passionate work, but it is also formally very sophisticated. The way things are painted, individual pieces overlap, and the complexity of the drawing suggests the complexity of modern

ELIZABETH MURRAY: COMING SOON TO A GALLERY NEAR YOU

List Visual Arts Center, MIT
(Paintings)

Museum of Fine Arts, Boston
(Drawings)

May 8 - June 28, 1987

**Museum of Contemporary Art,
Los Angeles**

July 27 - October 11, 1987

Des Moines Art Center

November 10, 1987 - January 3,
1988

Walker Art Center, Minneapolis
January 30 - March 27, 1988

**Whitney Museum of American
Art, New York**

April 21 - June 26, 1988

life—a conventional canvas might no longer suffice to tell the whole story."

Halbreich is gratified to see that M.I.T. is a stop on a distinguished tour that will take Murray's work from Dallas to Los Angeles, Des Moines, Minneapolis, and the Whitney Museum in New York City—where Murray made her art world debut in 1972. (See calendar.)

"Art-making is an experimental field," Halbreich muses, drawing an analogy to the scientific world. "It's about making false starts, about innovation. This show is one example of the role I would hope the arts could play at

With Sakharov in Moscow: "To Put It Mildly, a Memorable Visit"

marked copy to each letter and ph

M.I.T.—visible, progressive, innovative. Elizabeth Murray is a great painter, and M.I.T. should be championing greatness."—*Debra Cash* □

Students Praise Modest Rises in Tuition, Budget

Tuition at M.I.T. for 1987-88 will be \$12,500, up 5.9 percent from the current year. It's the smallest percentage increase since 1969.

Increases in room and board will bring the typical student budget for a year at the Institute to \$16,970, a 5.1 percent increase over 1986-87.

The self-help level—the amount an undergraduate is expected to earn or borrow before receiving financial aid from the Institute—will remain unchanged for the third year at \$4,900. Holding the self-help level constant means an easing of the burden on students who need financial aid.

The Tech welcomed all three decisions—"a pleasant surprise [that] shows an awareness of student needs," said an editorial. But, as *The Tech* noted, the self-help level "is still leaps and bounds above that at comparable institutions." And that discrepancy "most certainly takes its toll when highly qualified high school students decide to enroll where their cost is not so great."

Brian Moser, '87, president of the Undergraduate Association, was also pleased. "Dr. Gray is to be commended for his conscious decision to keep tuition as low as possible. M.I.T. no longer wants to be known as number one when it comes to tuition."

According to M.I.T.'s Office of Financial Operations, the cost of educating an undergraduate next year, exclusive of room and board, will be about \$22,500. The difference between this figure and the tuition paid by students has to be met from earnings on endowment and by unrestricted gifts and grants, President Gray noted. □

The liberalization of Soviet social and intellectual affairs that is credited to General Secretary Mikhail S. Gorbachev provided Professors Bernard Feld, Herman Feshbach, Ph.D. '42, and Jerome B. Wiesner with remarkable days in Moscow early this year. All three visited with Andrei Sakharov, the Soviet physicist released from internal exile in Gorky late last winter, and all three returned convinced that greater freedom of thought and political action is a major but fragile change in Soviet policy that deserves and needs every support the United States is able to offer.

Institute Professor Feshbach (physics) had planned to attend an international meeting in Vienna on European security and cooperation on human rights. But when Sakharov and his wife Elena Bonner were freed, Feshbach was invited to go first to Moscow.

And on the very evening of his arrival Feshbach had the extraordinary and unexpected experience of dinner with Sakharov and Bonner in their Moscow apartment. The visiting continued during the following day, and finally Feshbach went to Vienna with a statement written by Sakharov to be read there.

"It was, to put it mildly, a memorable visit," says Feshbach.

Ten days later, President Emeritus Wiesner and Professor Feld, former editor of the *Bulletin of Atomic Scientists*, were invited guests at the Soviets' International Forum for a Nuclear-Free World, for the Survival of Humanity.

There they met Sakharov; and they too came away convinced of the wisdom of high-level Soviets who describe Gorbachev's program as "a second Communist revolution." Wiesner believes Gorbachev understands that "you can't run a modern society without intellectual freedom," and he and Feshbach agree that (in Feshbach's words) "it is a hopeful time—certainly a critical time. It's a time to be optimistic and a bad time to be negative."

"President Reagan has it in his power to make it easier or harder" for the So-

viets to move toward greater freedom, Wiesner told Charles H. Ball of the M.I.T. News Office. "It's my personal opinion that it's in everybody's interest to make it easier."

Surprising Move Toward Openness

Feshbach found Sakharov apparently well and "vigorously pursuing human rights issues as well as recent developments in particle physics and cosmology." Sakharov often emphasized that "liberalization of Soviet society is essential for scientific and technical progress," says Feshbach. "A closed society is dangerously unstable."

Here are some of Feshbach's notes of Sakharov's comments during their hours together:

1. Sakharov gave highest priority to the release of prisoners of conscience, including not only the dissidents but also Crimean Tatars, Germans, Jews, and Pentecostals. There are about 700 such individuals whose names and sentences are known to Sakharov. But he believes that the total is closer to 2,000.

2. The other most urgent needs are freedom of thought and conscience, religious freedom, freedom to distribute information, and freedom to travel and to choose one's country of residence.

3. Exchanges, especially scientific exchanges, are important and should be increased in every possible way. But the need to release prisoners and guarantee personal freedoms in the Soviet Union should be stressed whenever exchanges are discussed.

4. There is a strong connection between arms control and openness. Indeed, the important issues in arms control are not technical. Nontechnical political issues dominate. For example, it is difficult to develop the necessary trust between East and West when the Soviet society is closed or the rights of minorities and dissidents are violated.

5. Sakharov opposes "packaging" in arms control negotiations—for example, the Soviet coupling of SDI with other arms control strategies in the Reykjavik

to to Feshbach, with 1 extra copy.



Called to Vienna for an international conference on human rights, Institute Professor Herman Feshbach, Ph.D. '42, suddenly was rerouted to Moscow to visit (below) with Elena Bonner and her husband, physicist Andrei Sakharov, upon the latter's unexpected release from internal exile. Ten days later President Emeritus Jerome B. Wiesner (left) met Sakharov at the Soviets' forum for a nuclear-free world. Both returned convinced that the Soviets' movement toward intellectual freedom is a major but fragile policy change for the USSR.



proposals.

6. Sakharov believes that SDI is not a major issue. It will not work with sufficient reliability—there are too many technical unknowns, and it has no effect on the usefulness of such weapons as cruise missiles and submarine-launched missiles. It is more important to obtain agreement in other areas, particularly to liquidate offensive weapons and thus expedite agreement on defense.

7. The change with respect to openness in Soviet society has surprised everyone. How deep is this change Sakharov cannot be sure. There is some evidence of reticence—the case of Marchenko, for example, who died during a recent hunger strike, and the new

Soviet emigration regulations that remain in violation of international accords.

A Fragile But Vital Optimism

Both Wiesner and Feshbach have in the past invited Sakharov to come to M.I.T. as a visiting scientist; would he come now? Feshbach asked. Sakharov has no present plans to seek permission, was the answer. If the Soviets want him to travel abroad, they will take the initiative and tell him.

Everything that Feshbach reads since his return from Europe confirms the private information that he also receives: the process of liberalization of Soviet so-

ciety is continuing. Wiesner emphasizes a change in mood that he observed in Moscow, from discouraged at the time of his last visit two years ago to "very positive" today. The attitude is "almost like a celebration," he told Ball. But he also noted that powerful forces in the government—the Communist Party and the industrial bureaucracies that are most threatened—are arrayed against liberalization.

Feld, too, found Soviet friends convinced that the changes are "significant." To skeptics who see Gorbachev's moves as "grandstanding," Feld replies, "We have to assume that they aren't, or otherwise we'll ensure that they are."—*John Mattill* □

15

Hi '15ers. A note from **C. Ellis Ellicott, Jr.** of Baltimore, Md., tells us he has moved. His new residence is only a couple of miles from the old one, so he is in familiar surroundings and can still use his food store, drug store, bank and post office. He mentioned Maryland was having its share of snow and icy roads. Ellis was glad to get my letter, and I was mighty glad to get his, and I am looking for more from you '15ers! . . . Talked to **Bob Warren**, and he, too, is kicking on all cylinders and giving me good advice: (Am I lucky? Oh yes!)

We continue with **Loring Hall's** senior year diary notes.

December 5, 1914: In Engine Lab this a.m., I was in charge, with **Bill Holway** and **John Hepinstall** as assistants. Our assignment was to determine the horsepower of a single cylinder gasoline motor. Came back to 16 Exeter St. in the evening. **Dix Proctor** and **Warren** were initiated into the fraternity. **Bob Sherman** from Manila was there.

December 8, 1914: After lunch a group of us from Course I, bridge design, met at Kendall Square. Mr. Barker conducted us to the shops of the Boston Bridge Works. We got a first-hand view of how a steel structure is fabricated. Back home I studied hydraulics and structures until midnight.

December 11, 1914: Worked with **Bill Holway** on our Engine Lab report for tomorrow. After supper attended a regular meeting of the C.E. Society, where Prof. Whipple was the speaker. Sat with **Edgar Bascom**, **Art Bond**, and **Al Clarke**. Collected some dues and sold some pins. When it was over, went to Eleanor Weedon's birthday party. **Ed Whiting** was there, also **Joe Livermore**, and **Ray Greene**. Ray drove me home in his new Mercer. Studied until 2:45 a.m. Quite a day!

December 15, 1914: Voted in the city election for the first time. Had a chance to vote "no" on the liquor license proposal. Talked to Mr. Barker for a while at bridge design and decided I had misjudged him. He is a good guy after all. Worked on the "Viaduct Tower" problem all evening.

December 19, 1914: Went bowling at Hibernia Alleys with **Harvey Daniels** and **John Gallagher**. It wasn't as easy as it looks to knock down those candlepins. My average was 85 for five strings. John was the champion.

December 20, 1914: By special arrangement with the chief engineer of the B&A Railroad, a group of Course I men met at Riverside at 6 a.m. to watch the installation of a new concrete bridge over the river. After the 6:20 train went through, the old tracks were ripped up and the new bridge went in on rollers, pushing the old bridge ahead of it. The operation took only a little over two minutes. It was quite impressive. Walked in to Newtonville with **Carl Lovell**, **John Hyneman**, **Harry Murphy**, **Jesse Potter**, and **Ed Stelle**.

December 24, 1914: Worked on bridge design with **Nel Stone** and **Howard Thomas**. At 12 o'clock met Kay and took her to lunch at the Bristol Cafe. Had a good steak and all the accompaniments for \$1.65. Then we went to Franklin Field

for an afternoon of skating. Had a wonderful time.

December 25, 1914: Christmas—had a fine day with the family. For presents I received a skating cap, a shirt, several ties, leather billfold, stick pin, tie holder, diary, a dollar from grandma, pajamas, slippers, and Kay's picture.

December 31, 1914: Back again for another month of concentrated work. **Highley** and I consulted with Prof. Hayward and Mr. Holmes, resulting in a change in our plans for the thesis. It is going to involve some tests on rivets that have never been performed before.

Well, '15ers, we will work on the year 1915 in the next issue. I am writing personal notes to each of you and love to get replies. Spring and summer are now upon us . . . enjoy the nice weather!—**Joyce E. Brado**, Class Agent, 491 Davison Rd., Apt. 9, Lockport, NY 14094

16

The move from Chelmsford to Pocasset is nearly completed, and now I can get back to the important and pleasant responsibility of our class notes. . . . **Dan Comiskey** called early this year to let me know that he is well and continues to be active in the senior citizens group in his area.

Early in February, I had this nice note from Professor **John Fairfield**: "Do I infer rightly that you are retired from granite in favor of salt sea air sniffing? I envy both the retirement and the ocean air. Miss the Cape Cod reunions. I had wondered why no '16 column. Assumed laziness on our part in writing to you. No news. Spent Christmas at daughter's near New York City. Most pleasant—but like the 'Man Who Came To Dinner,' who fell and became a pest to the hostess (a hilarious comedy), I fell (no New Year's celebration liquor) on a bright sunny morning with no snow or ice (just clumsiness). I involuntarily was a guest for eight days until I improved and and could navigate without a cane and could go home. Back to a hermit-bachelor existence in the same house in which I have lived for 53 years. There was 18 inches of snow on the lawn and five to ten feet along the walls and the road. My dog is frustrated, since he can't explore, ramble, or entice me for a walk. Now I'll concentrate on the garden catalogues with those luscious pictures. Best to you."

It was good to read in February/March issue of *Technology Review* that **Alexander Brest**, **Will Wylde**, **Dina Coleman**, and **Doug Robertson**, as well as Mrs. **Jap Carr** (Hildegard) and Mrs. **Francis Stern** (Gladys) are listed among the donors to the Alumni Fund. That's great!

Please note the following change of address. Send your letters to me at this new address.—**Bob O'Brien**, Acting Secretary, 25 Keith Rd., Pocasset, MA 02559

18

I am indeed grateful to our class for further 1987 greetings that arrived too late for earlier publica-

tion. They come from Lorraine and **Stuart Caldwell** of Rockport, Mass., **George Halfacre**, **Len Levine**, **Herb Larner**, and **Eleanor Kilduff** of Rye, N.H. (who, I believe, is now—February—sunning herself in Florida).

George Halfacre has been retired since December 1965. He gardens and does his own housework. He is one of a big family and claims that a week never passes without a family visit. Such things help to keep one on the go, he claims. . . . **Len Levine** is ever busy and doing. He writes, "By the time this goes to print, I will have reached 90. I gave up my car, as I was beginning to turn down the wrong streets. Have slowed down but keep fairly active. The Newton Retired Men's Club, Brookline Retired Men's Club, B.U. Evergreen, and several bridge games a week have allowed me to make many new friends (mostly younger). I see **ELE Eli Berman** once in a while."

Although **Herb Larner** is finding it difficult recovering from the loss of Mildred, he reports that he is starting a new life in Maryland, where he has a nice cottage and is making many new friends."

I am very happy to include a brief review of the well deserved honors accorded **George Woodruff** for his many accomplishments in a successful career in his native Georgia. Mercer University awarded him an honorary doctor of laws degree in 1979, as did Emory University in 1980. In 1986, in connection with their centennial celebration, the Georgia Institute of Technology honored George by designating their School of Mechanical Engineering as the George W. Woodruff School of Mechanical Engineering. Also, on his 91st birthday last August 27, Emory University paid him the additional honor of breaking ground for a residential hall to be known as the George W. and Irene K. Woodruff Hall.

We record with sadness the death of **Winifred Wiley** last December 19 in Harpswell, Maine. I recall with pleasure our times together on happy occasions.—**Max Seltzer**, Secretary, 865 Central Ave., Needham, MA 02192; **Len Levine**, Assistant Secretary, 519 Washington St., Brookline, MA 02146

19

A few words about your class secretary reported in the third person. . . was hit by a stroke the day before Thanksgiving last year and has been hospitalized ever since unable to do much of anything. Improvement is in motion, and he will go home soon. Meantime sorry the notes for the *Review* were missing.

Francis R. Weiskettle attests to his appreciation of our class notes. Like other classnotes he says he is happy to be alive and well. This year he did not make his annual trip to Disney World with his retarded son. He may have a Class Record.—A grandchild who is 4 years old. Would readers comment?

Bob MacMullin and his wife Olive issue an annual Christmas and New Year's greeting with interesting comments on their lives together, and we have enjoyed being on their mailing list. A

paragraph concerning Bob follows. "Bob, age 88 on September 18. Health robust, but his daily Roman mile comprises 1,020 paces instead of 1,000. Deaf, wears two hearing aids. Almost blind, cataract on top of macular degeneration of retina. Had cataract surgery on one eye and lens implanted. Can still read with Visualtek device at 30 times magnification. Pleasures: listening to books-on-cassett. My education continues!"

We must report the death of **David Arthur Lindquist** on October 8, 1986. His home address: 1150 Ponce De Leon, Clearwater, FL 33576. The report is made by the Alumni Association based on a note from his daughter, Doris Wolfe. David died in his 91st year, after a career as a naval architect. He was an engineer and veteran of both world wars. If we receive more details, we will pass them on to you. Personally, I recall Lindquist in our freshman year together, and I enjoyed his association at that time.—**W.O. Langille**, Secretary, P.O. Box 144, Gladstone, NJ 07934

20

George Wilson, Jr., has thoughtfully sent me a booklet on the 1920 graduation exercises that he found in his late father's effects. It contains a complete listing of the class, which numbers three doctor of science degrees, 50 master of science degrees, and 321 bachelor of science degrees.

Space does not permit mention of the entire roster, but at the risk of neglecting some of your old friends, I shall mention a few of them that caught my eye for remembrance sake: **Ken Akers**, **Art Atwater**, **Ernie Bangratz**, **Bill Barron**, **Herb Bates**, **Harold Bibber**, **Karl Bean**, **Ralph Booth**, **Fred Bowditch**, **Frank Bradley**, **Skeets Brown**, **Perk Bugbee**, **Buzz Burroughs**, **Al Burke**, **Phil Byrne**, **Hank Caldwell**, **Warren Chaffin**, **Archie Cochran**, **Hank Coveh**, **Jack Coyle**, **H. O. Davidson**, **Harmon Deal**, **Bill Dewey**, **George DesMarais**, **Herb Dorr**, **Count Dumas**, **Freeman Dyke**, **Snug Etter**, **Ed Farrow**, **Herb Federhen**, **Dave Fiske**, **Dick Gee**, **Jim Gibson**, **Dolly Gray**, **Ben Groisser**, **Phil Haebler**, **Bill Hedlund**, **Henry Hills**, **Bill Honiss**, **Homer Howes**, **Ernie Huntress**, **Harry Kahn**, **Leo Kahn**, **Merrill Knox**, **Pete Lavedan**, **Mal Lees**, **Jack Logan**, **Henry Massey**, **Mouse Meissner**, **Dusty Miller**, **Jimmy Moir**, **George Morgan**, **Ned Murdough**, **Jack Nolen**, **Ming Pai**, **Art Radasch**, **Chuck Reed**, **Ray Ridgway**, **Robbie Robillard**, **Ken Roman**, **Sam Schenberg**, **Jim Scott**, **Abe Shlager**, **Harold Smiddy**, **Dode Spiehler**, **Creighton Stanwood**, **Bob Sumwalt**, **Bat Thresher**, **Ned Van Deusen**, **Scotty Wells**, **K. B. White**, **George Wilson**, **L. D. Wilson**, **Larry Winant**, **Jim Wolfson**, and **Phil Young**.

As I mention them, their likeness comes vividly to mind. I hope they will stir up fond recollections. Apologies for omissions.

A welcome letter from **George DesMarais** of Norton, Ohio, says that the Wason dynasty at M.I.T. brings to mind that **Herb Federhen** was also the third of his family to live at M.I.T. George reports the good news that his wife Lois is improved in health and spirits. He has three great-grandchildren. All are doing well and are worthy representatives of the DesMarais clan.—**Harold Bugbee**, Secretary, Apt. 313, Country Club Heights, Woburn, MA 01801

21

At our reunion last June, your secretary-treasurer made a motion that our class funds be turned over to M.I.T. The motion was defeated because two classmates wanted some control of the funds. It has now been arranged to set up an account with M.I.T. whereby the funds (about \$6,200) can be drawn upon or added to as needed. It is doubtful if we will have additional call on the funds. The previous accounts—money market fund and savings account—have been closed.

Roy Campbell of Bath, Maine, celebrated his

90th birthday on December 20, 1986. Roy writes, "I went to Harvard University-M.I.T. School of Public Health and finished my work in January 1921. In that same class was the father of the present king of Thailand. Harvard later gave each member of that class a master's degree in public health."

A letter from Louise Baldwin informs us that her mother, **Helen (Mrs. Irving) Whitehouse** of Arcadia, Calif. died on June 28, 1986. Our sympathy goes out to her family.—**Sumner Hayward**, Secretary, Wellspring House E64, Wash. Ave. Ext., Albany, NY 11203; **Samuel E. Lunden**, Assistant Secretary, 6205 Via Colinita, Rancho Palos Verdes, CA 90274

22

When in Florida this past winter, I had the pleasure of driving from Sanibel to Venice to spend the day with **Madeline and Parke Appel**. Their home is a well appointed pleasant fourth-floor condo directly on the Gulf. Both are well and will be heading up our reunion at Cambridge in June. I also had a visit with **Harold Burnham** who with Mrs. Burnham spends six months at their home on Sanibel and six months at their home at Manset, on Mt. Desert Island, Maine. Harold transferred to Dartmouth after his sophomore year at Tech but, in spite of that, pursued a successful engineering career.

1986 Boston University Medical School established a John W. Strieder Visiting Professorship in cardiothoracic surgery honoring our classmate who was chief of Cardiothoracic Surgery at University Hospital and Boston City Hospital for 20 years (1946-1966). We look forward to seeing John at reunion along with his Lambda Chi Alpha fraternity members, **Bob Tonon** and **Lee Carroll**. Word also reaches me that **Vernon Whitman** plans to be at the reunion.

Bill Elmer has favored me with copies of some amusing correspondence with the congressman from the 15th Texas district, **Kika de la Garza**. A picture of the congressman with an oil painting appeared in the December 8, 1986, issue of *Insight*. The squib under the picture says that de la Garza bought the painting at an auction to benefit the Gladys Porter Zoo in his district. The final comment: "Incidentally, the artist is a precocious 5-year-old named Guero. The primal urgency so evident in the work probably owes to the fact that Guero, a resident of the zoo, is an orangutan." This prompted Bill to write to de la Garza requesting a copy of the painting on the ground that he wanted to send it to President Gray, "with a plea to either hang it in his office, as you are doing, or to realize that the junk decorations around his campus ought to be relocated where they really belong, in the nearest junkyard." This stirred de la Garza to action. He had the House of Representatives photographer come to his office and take a snapshot of the painting. Two fine color prints were sent to Bill—"one for M.I.T. and one for him." The sequel to this exchange has yet to come to my attention.

John Alden Plimpton died September 25, 1986, at his home in Juno Beach, Fla., at age 87. He served as a private in the army in World War I and as an officer in World War II, rising to the rank of full colonel. In his business career, he worked for the Pennsylvania Crusher Co., from which he retired in 1952. He held patents for a coal miller feeder, coal breaker and cleaner and special deflector for a mill. In 1984 he made a trip by car around the country logging 14,099 miles in 42 days. He was a member of the Audubon Society, Friends of the Everglades, Palm Beach Historical Society, M.I.T. Club, Ancient and Honorable Artillery Co., the Mayflower Society, the John Alden Kindred Society, and was a director of the Society of John Plimpton Descendants from 1977 until his death. He is survived by his wife Dale, two brothers (Robert and Henry), a sister (Elizabeth), two sons, (Jack and Bob), a daughter (Barbara), nine grandchildren, and eight great-

grandchildren. The condolences of the class are extended to his family.

Our 65th is next month.—**Yardley Chittick**, Secretary, Rte. 1 Box 390, Ossipee, NH 03864

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Howard Lockhart writes that he has been retired since 1966, has done some consulting, and has traveled to Italy, Cuba, and California, and southern parts of the U.S. His son is a captain in the navy and has his own ship, the *Valley Forge*. . . . **Leander Poor** is director/treasurer of Rossmoor Mutual #11 Condominium Association but is terminating in April 1987 and slowing down. A Rossmoor M.I.T. luncheon group meets each month when attendance warrants. . . . **F. La Verne Smith** of 13048 Del Monte #42C, Seal Beach, CA 90740, would like to hear from any classmates in the area.

Samuel Levine died September 20, 1986. He was a civil engineer for the Massachusetts Department of Public Works in Boston and office engineer for the Massachusetts Turnpike Authority. He was a member of Congregation Tifereth Anshel Sfard and Sons of Israel in Lawrence, Mass.

Frank Travers died April 19, 1986. He began his career as marketing research manager of Eli Lilly and Co. in Indianapolis. From 1942 to 1945, he served in the U.S. Navy as lieutenant, lieutenant commander, and chief of naval operations, Washington, D.C. He then joined the Lincoln National Life Insurance Co., Fort Wayne, in investment research, then was financial secretary and second vice-president in charge of securities. From 1948 to 1968, he was vice-president in charge of securities of the American United Life Insurance Co., Indianapolis, was elected to the board of directors in 1954, and retired in 1968 but continued as a consultant to the finance committee.

He organized and became the first president of the Indianapolis Financial Analysts Society. He was active in numerous professional and civic organizations. He was a trustee of St. John's Church and Marian College, where he was awarded an honorary degree of doctor of business administration. He also enjoyed golf, working on his property, bridge and gin rummy, travel and modern languages.

William Vicinus died July 1, 1986. After graduation, he helped found the firm of Whitmore, Rauber, and Vicinus, a construction and consulting firm. In 1942, he left the firm to become owner-operator of a gypsum quarry in Bay City, Mich. In 1948 he joined General Motors Corp.'s overseas operations as a construction engineer in Sao Paulo, Brazil, which led to the position of consulting engineer for the government of Brazil. In 1951 he became chief structural engineer for the Atomic Energy Plant at Paducah, Ky. In 1956 he became resident engineer for Vern E. Alden Co. of Chicago on new nitroglycerin and dynamite plants. In 1959 he served with the Dew Line as area superintendent, then moved to the missile field with Arthur D. Little Co. and Martin-Marietta in Denver, and lastly to the Metropolitan Water District of southern California. He was president of the M.I.T. Club of Rochester. He enjoyed tennis, golf, and swimming. Bill was my tentmate at the summer surveying camp in Maine in 1922.—**Richard H. Frazier**, Secretary/Treasurer, 7 Summit Ave., Winchester, MA 01890

24

News of snow storms, freezing rain, and skiing conditions is more prodigious than that of classmates, but **Douglas Montgomery** came through with what your secretary would appreciate more of, "I am in good health and active. Daily exercises, short local trips now and then, occasional dining out, as well as reading and study in order to keep abreast of the advances and changes in science and technology keep me busy."

An Alumni Pledge Form records that Col. **John B. Gegan** passed away January 26, 1986, in Providence, R.I., where he had retired years ago. Your secretary knew him there when he was running the New England Telephone and Telegraph Co. area. John was formerly in the U.S. Army and had been awarded a Bronze Star, Purple Heart, and Croix de Guerre. He earned his S.B. in electrical engineering.

The Alumni Association received an envelope addressed to **Donald C. Harker** and forwarded by **Howard Patch**, advising that Don had died November 26, 1986 in Jackson, Mich. After gaining his S.B. in 2 years, he was awarded an N.S. by the University of Pittsburgh. He joined the Westinghouse Electric Corp. in East Pittsburgh, Pa., and worked on the design of large circuit breakers. In 1946, he became System Planning Engineer for the Commonwealth & Southern Corp., Jackson, Mich. He retired in that city.

We have word from Julia, wife of **Joe Wah Young**, that he passed away October 31, 1986 in Fullerton, Calif. He was granted his S.B. in civil engineering. He came from China and attended school in Holyoke, Mass. He joined Palmer & Turner Co. in Shanghai and later lived in Greenville, Miss., then moving to Fullerton, Calif. He was a member of the Chinese Students, The Cosmopolitan Club, and the Civil Engineering Society. Joe is remembered as a spark at the M.I.T. Summer Surveying Camp, East Machias, Maine.—**Russ Ambach**, Secretary, 216 St. Paul St., Brookline, MA 02146, (617) 232-0634

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The citizens of Southbury, Conn., were saddened when they learned that **William "Rick" Wheeler** was stepping down from the board of selectmen on January 1, 1987. When Rick retired from AT&T in 1969, after working for that company from the time he graduated from M.I.T., he moved to Heritage Village in Southbury. He soon became active in local church and civic activities. He was elected to the board in 1975 when it was expanded to include six selectmen. An editorial in the local paper states that from the beginning Rick was generous with his time and talents in a cause that offered no other compensation than the "rewards" of elective office. Rick's effectiveness as a selectman grew out of his skill at charting common ground in the rough and tumble landscape of local politics. We congratulate Rick for his accomplishments in Southbury.

Sam Spiker has provided your secretary with this information. Sam makes his winter headquarters in Brookline, Mass., but has plans to make brief trips to New York, Washington, D.C., Ohio, and California. He will also spend a month in Naples, Fla.

We regret the passing of **Warren L. Nye** on October 17, 1986, in Bloomfield, Conn. He leaves his wife Nancy Harris Nye and three daughters: Mrs. Albert Ash of Bloomfield, Conn.; Mrs. Donald Donovan of Union Grove, Ala.; and Mrs. Stuart M. Davis of Vinalhaven, Maine, as well as eight grandchildren and six great-grandchildren. A memorial service was held at Christ Church Cathedral, Hartford, on October 21.—**F. Leroy "Doc" Foster**, Secretary, 434 Old Comers Rd., P.O. Box 331, North Chatham, MA 02650

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Some news was routed recently to Karnig S. Dinjian, secretary for class of '29. He sends it to us:

"Two new honors have come to **James R. Killian, Jr.**, who needs no introduction. In November, he received the William C. Foster Award from the Arms Control Association at its annual dinner in Washington, D.C. As the first presidential science adviser to President Eisenhower, Dr. Killian was honored for his integrity, leadership, and commitment to problem solving that set the stage for subsequent arms control achievements.

Earlier, he received the Director's Award of the Institute for Educational Radio-Television. He was cited for heading the Carnegie Commission on Educational Broadcasting, which led to the Public Broadcasting Act of 1967.

"I regret to announce to you the death of Elizabeth (age 79), beloved wife of our Jim Killian, which occurred last November after a long illness and hospitalization at the Massachusetts General Hospital. A former longtime Wellesley resident and a native of Franklinville, N.C., she met Jim while she was a student at Wellesley College and he was editor of *Technology Review*. When Jim retired as president of M.I.T., the late John Burckard, dean of M.I.T.'s School of Humanities and Social Sciences, wrote that Killian's marriage was a beautiful and marvelously productive partnership from which M.I.T. so richly benefited. Elizabeth participated in M.I.T. activities throughout her husband's career there and worked with him on assignments beyond academia, including his appointment as the first White House science adviser."—ed.

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Brush off the dust from your red jackets and get ready to come to our 60th. The committee has a good program planned. The Hyatt Regency has provided special rates and good rooms for us old timers.

Donald F. Horton of Gathersburg, Md., was a civil engineer with Corps of Engineers from 1927-1940 and staff assistant, Office of Secretary of Defense 1954-1968, with active duty during World War II was awarded Legion of Merit. Don retired as colonel AUS in 1966 having served continuously since graduation. He is a fellow (life member) of American Society of Civil Engineers and life member of the American Military Engineers.

Grenville B. Gerrish of Melvin Village, N.H., moved to New Hampshire in 1971. He has had an active career in sales, manufacture, and consultation in food baking equipment, freezing equipment, and air quality. He holds patents on drying ovens for producing egg cartons and is a life member of the American Heating and Air Conditioning Engineers Association. He and wife Madeline enjoy New Hampshire life on Lake Winnepesaukee.

Charles F. Sweet, Jr., of Milford, N.J., has been a vacuum engineer with Ingersoll Rand in New York. He was chief engineer of Ejector Division and supplied vacuum equipment for 60 percent of the orange juice industry, as well as equipment to test the first space capsules. He retired in 1970. Charley suffered cancer twice and survived with treatment. He continues to enjoy retirement, his photography hobby of documentaries of weddings, and social parties.

Samuel S. Auchincloss of Englewood, Fla., has had a varied and distinguished career. He was vice-president of New York quotation Co. from 1930-1940. He entered the Signal Corps in 1940 and was signal officer of the 1st Corp for General Eichelberger through the campaign in New Guinea. Then he became deputy chief signal officer for GHQ under General MacArthur from Brisbane to Tokyo and was in charge of all planning for his Signal Section. After the war, Sam was industry officer for the Marshall Plan in Sweden.

Back in the U.S. he held various executive positions with companies owned by AMF until 1957. Then he became president and later chairman of TracerLab, Inc. in Waltham and in 1961 arranged to merge with LFE. The company was a world leader in development of equipment using radioisotopes in industrial, medical, scientific, and military applications. It also manufactured X-ray equipment for the medical profession.

In 1965 Sam was elected president and later chairman of AMP Inc. of Harrisburg, Pa. This company was a pioneer in solderless crimp type electric wire terminals that are in universal use today. Sam retired in 1972 and moved to Englewood, Fla., but retains his position as director

60th Reunion

emeritus of the board. He and wife Lydia have enjoyed cruising the Maine coast in *White-tail*.

Howard O. Woods of Wallingford, Vt., and Scottsdale, Ariz., died on March 3, 1986. He was a Course VI-A electrical engineer. He held positions with General Electric Co., Towle Manufacturing Co., was director of marketing for Bird and Son, general sales manager for Swank, Inc., and an independent management consultant.

Thomas J. Scott of Arlington, Va., died on March 27, 1986. He was a retired assistant chief of the Chemical Division of the International Trade Commission. During World War II, he served in the army in the Pacific area. He retired from the army reserve as lieutenant colonel in 1964. Tom was with the U.S. Trade Commission 37 years and retired in 1974. Our thanks to his widow, Irene, for his obituary. She has been a judge on the Federal Tax Court in Washington. They traveled extensively during their active years.

Otmaz Praznick of Quincy, Mass., died on April 18, 1986. He was a naval architect all of his career with the Bethlehem Steel Fore River Works until 1960 and then moved to Baltimore with their Sparrows Point Works. He retired in 1967 and moved back to Quincy to be near his son Anthony, '55, in North Weymouth.

We regret the delay of these death notices, but relatives are slow to notify the alumni office. We thank the widows and families for their assistance.—**Joseph C. Burley**, Secretary, RFD 3, Epping, NH 03042; **Lawrence B. Grew**, Assistant Secretary, 21 Yowago Ave., Branford, CT 06405; **Prentiss I. Cole**, Assistant Secretary, 2150 Webster St., Palo Alto, CA 94301

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As you read these notes, the 60th reunion of our class will be only a short year away. Our past major reunions, held on campus with housing at McCormick Hall, have been invariably highly successful. Again, we are assured of the full support and cooperation of the Institute for this next gathering of our class. It is bound to be a memorable occasion! M.I.T. Night at Pops will be on Thursday, June 2, 1988, with Technology Day on June 3. These events will be included in our program during the several days of our stay on campus. We recommend that you now reserve the period June 1-5, 1988, so as to fit in with the final plans for our 60th. Please send in your notice of expectation or plan as soon as you can—this will help **Abe Woolf** and his committee in making the best possible arrangements for your convenience and enjoyment.

The account of our Mississippi River steamboat trip prompted **Carroll Smith** to write and tell us of a trip he had taken as a boy with his sister and dad on the old Mississippi River sternwheeler *Helen Blair* from Quincy, Ill., to Davenport, Iowa, to visit relatives. Smitty lives in Edgewater, Fla., but likes New England and has a growing library of books relating to that region. He expects to be at the 60th.

Jim Donovan has received several letters of cheer and good wishes from classmates. One from **Rene Simard** is very entertaining and tells of his trip with Pam to the Orient. At one point near the lofty border of Nepal with Tibet, a rock slide blocked the roadway ahead of their bus. This called for a steep climb on foot up the mountain over loose terrain to the next level some 200 feet higher up. At the altitude of 12,000 feet, neither Rene or Pam could make the climb. They had to be carried up piggyback by the rugged Sherpas who had gathered to transfer baggage from the immobilized bus to another bus waiting above. So for a short time the Simards shared status with the baggage. Rene also hopes to see us all in 1988. . . . Another class faithful, **Bill Hurst**, wrote Jim an encouraging note and offered the benefit of his own health and medical experience.

We have other enthusiastic class travelers. **Bill Shenk** says that he still travels overseas and spends several months annually at Falmouth,

Mass. . . . Marjorie (Mrs. **John A. Carvalho**) has blossomed into a real world traveler. She sold her home a year ago and is now apartment living. . . . We also had the pleasure of receiving notes from Frances (Mrs. **Carl F. Myers**) and from Helen (Mrs. **Robert E. Murphy**).

With deep regret we must at this time report four class-related deaths. **Chester M. Day** died on January 12, 1987. Chet had been provided with a mitral heart valve in 1979 and wrote recently saying that the valve was still functioning but lately other heart complications had become evident. Following graduation in Course VI, electrical engineering, Chet went on to receive his master's degree in that same department. His professional career was with New England Telephone and Telegraph Co. We talked with his wife, Bettie, by telephone and expressed to her our sympathy on behalf of the class. Chet left also two sons and four grandchildren.

A note from **Bob Hunn** informs us that his wife Dorothy died January 31, 1986. They had 50 good years together and cherished their relationship with M.I.T. and '28. Bob says the 55th reunion group picture hangs on the wall of their home, which is now something of a museum covering their lifetime together. Bob has a very supportive family based around three sons and seven grandchildren. His welcome sign is always out. . . . We had a telephone call from **Roger Haven** in Fryeburg, Maine, telling us that his wife Priscilla had died that morning (January 29, 1987) at home. From previous conversations with the Havens, we were already aware of Priscilla's failing health.

. . . A letter from the family of **Edith (Mrs. Raymond L.) Wofford** informs us that she died in July 1986. (Ray died in 1984). . . . We take this opportunity to express sympathy for the loss of all these members of our class family.—**Walter J. Smith**, Secretary, 37 Dix St., Winchester, MA 01890

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I would like to correct a simple arithmetic error in the January 1987 issue of the *Review*. **Laurence "Larry" Moses** of Sarasota, Fla. was listed the youngest surviving member of our class. That biological distinction belongs **Samuel J. Levine** of Swampscott, Mass., who was born on September 12, 1909.

Warren A. Spofford of Tyler, Tex., writes, "I continue to have good health and I am active with church, AARP Meals on Wheels and other senior citizen activities. Thanks for remembering my birthday." . . . From **Laurence D. Luey** of Birmingham, Ala., "Couldn't help but notice from class notes how many class members had their 50th wedding anniversary this year. My wife Natalie and I add our names to this list. Sara and **Amasa 'Mace' Smith** graced and enlivened our party. I have no special accomplishments to report other than living another year of trivial pursuits. Such pursuits include a couple of auto trips, some low quality golf (some with Mace's group), and trying to learn how to take advantage of a computer under the patient guidance of Howard Chinn, '27. **Rolf Zurwelle** and I continue to keep in contact. We were roommates at M.I.T."

Richard E. Bolten of Westmount, Canada, writes "I revisited Boston last spring for three days and walked the Hill the whole of one morning. Thirty years ago, our firm designed the extension to the Montreal Neurological Institute for McGill University. A key figure was Dr. Herbert Jasper, who invented the EEG machine. Herbert is an old friend who lives in our building here. He and I drove down together to attend a conference of neuroscientists at M.I.T. and I was invited to some of the functions, including a dinner in honor of Dr. Willi Nauda. I spent some time walking around town visiting familiar haunts at M.I.T., Harvard, Beacon Hill, the Gardner Museum, etc. Life is not very easy these days. My wife Betty continues to get weaker and sleeps a

good deal. She has great difficulty in speaking even a few words and can no longer feed herself. Returning home from the hospital (17 miles) each day I become very depressed. Our children, family, and friends are very helpful and look after me well, but I have to get away just a few days every month. As my next birthday will be the 80th, one wonders about making the 60th reunion, but I certainly plan to give it a try. The idea of having events on or near campus should appeal to most of us."

Hyman J. Fine of Norfolk, Va., writes: "Although I am retired, I am busier than ever. I am involved in community projects, especially those helping elderly citizens. I participate in the Meals on Wheels program as well as taking patients to and from the doctor's offices and hospital appointments. I play tennis three times a week and attend seminars on public affairs and international problems. Have helped in reading programs for students at the high school level. My wife Edie has also retired but manages to continue contact with friends in the maritime and transportation community of which she was an active participant for many years." . . . **Richard C. Wood** of East Hampton, N.Y., has sent a brief note that at age 84 he is still designing and building houses. He is in good health and enjoying life as much as ever. . . . **Charles W. Sampson** of Rochester, N.Y., and his wife Sigrid are well and enjoy their retirement years by taking trips in their car to see their son and daughter in the summer months. They also eat out a lot in different restaurants. They have two children, two grandchildren, and one great-grandchild. . . .

Amasa G. Smith of Birmingham, Ala., writes, "I have been retired from the Chicago Bridge and Iron Co. for 15 years. I worked there since 1930 as vice-president in charge of the Southern Operations. I was also a member of the board. Now I enjoy retirement, keeping extra busy with civic projects." **Butler King Couper** of Tryon, N.C., writes, "I made a nice telephone contact with **Romeo H. Guest** of West End, N.C. Also received a card from **E. Neal Wells** of Pinellas Park, Fla. I have chatted by amateur radio with **George Chatfield**, '27, who runs the Rotarians of Amateur Radio (ROAR) NET on Sunday mornings. Tryon continues to be a popular retirement area with lovely scenery and good golf facilities. It is only 27 miles off the great North-South Highway (I-85). So drop by some day. Thanks for my birthday card which arrived on my 81st birthday." . . .

Putnam Cilley of Sharon, Mass., writes: "I just had a note from **Arthur Bearse** stating that he will not be able to attend the Alumni Technology Day activities next June. Hope he will change his mind. My wife and I are fine and enjoy traveling across the country visiting relatives and enjoying the change in scenery." **Arthur** and **Pat** have been friends for many years and have attended the Alumni Day activities for many years with your secretary. For some years, we three have held the "Fort" for our class. Last year **Arthur** informed me of his inability to attend for health reasons. **Pat** and I were delighted when he showed up with his wife **Claire**.

I received a nice letter from **Sam Levine**. He writes, "I retired from GE over 12 years ago at the mandatory age of 65. Then for the next eight or nine years, I did consulting work, mostly for GE. In between, my wife **Emma** and I traveled extensively over a good part of the world. Our two children have provided seven grandchildren. Five are currently in college, two in high school. None of the seven have shown any interest in going to M.I.T. Their schools are Cornell, Yale, Williams, Northwestern, and the University of North Carolina at Chapel Hill. Except for accidents, such as slipping on ice and breaking a bone and **Emma's** breaking a bone near her hip, our health has been quite good."

George J. Meyers and his wife, **Barbara** write: "We started the year at **Brad's** in Miami. Aside from watching our three granddaughters sprout, we took a trip to Everglades National Park, bicycling the 15-mile **Shark Valley** loop. We saw

hundreds of alligators and exotic birds. Last May and June, we had trips to Northfield—Mt. Herman for the Sacred Concert, **Anneliese's** (granddaughter) induction into Cum Laude, dinner, and then graduation. In August, **Jay**, **Bob**, **Brad**, **Bill**, and wives gave us a wonderful 50th anniversary celebration at the Inn at Williamsburg, Va. We are in good health. Still play tennis and are otherwise engaged in usual activities."

I regret to announce the death of **John F. Dreyer** of Cincinnati, Ohio, on December 31, 1986. His widow, **Trudy** writes: "After a rather long illness, **John** died, leaving undone many of his favorite projects. One of them was in connection with his work in liquid crystals. His hope was that the work would be carried on by a group of interested scientists at the University of Cincinnati, and it probably will. His intense interest in research was with him to the end." From the memorial services presented by Pastor T.W. Kalsbeek:

"We are here to celebrate the life of a man who used his divinely-given abilities in constructive pursuits, resulting in honor, not sought, but well deserved. As a good student of God's gifts, he used his mind well, earning a degree (with honors) from M.I.T., pursuing further education at the University of Cincinnati, while also working at the Formica Co., where he was responsible for a long list of significant new developments of benefit to that corporation. Many years were spent in independent research in his home laboratory, resulting in still more impressive developments, especially in the realm of polarizing processes, materials, and equipment. Formation of his own company known as Polacoat in 1946 was a milestone. His chief interest was in working with liquid crystals, doing his own research, serving as consultant to the University of Cincinnati and heading a team of scientists under contract from the U.S. Air Force. In recognition of his work in this field, he was awarded the honorary doctor of science degree by Kent State University in 1987." To the best of my knowledge, **John** did not attend any of our major reunions, but he was supportive both of M.I.T. and class affairs. Prior to our 55th reunion, he was one of the earliest to respond with his class dues, paying \$50 instead of \$25 and declaring his willingness to pay more if we happened to have a short fall of finances.—**Karnig S. Dinjian**, Secretary, P.O. Box 83, Arlington, MA 02174

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This month's longest communication is from **Langley Isom**, who writes from his retirement home at Yarmouth Port on Cape Cod. After graduating from M.I.T. in course X-A, **Langley** worked successfully for **Dewey** and **Almy Chemical Co.**, **Heveatec Corp.**, and **Reeves Bros.**, largely on new product development and sales of specialty rubber products and coated fabrics. At about the time of his retirement in 1971 his vision began to fade, and in 1972 he was declared legally blind. Although his impaired vision has substantially curtailed his activities, he did quite a creditable job of typing the letter he sent me. **Langley** lost his first wife, **Peggy**, about two years ago. Thereafter he became re-acquainted with **Mrs. Dorothy Knowlton**, who had at one time been married to **Albert Williams**, also course X-A and a good friend of **Langley's** at M.I.T. **Dorothy** and **Langley** were married in May 1986 and are living happily at his home on Cape Cod. If my arithmetic is correct, they have between them a total of six children, 14 grandchildren and two great-grandchildren.

By coincidence, returns have come in this month from two classmates, **Ed Hawkins** and **Wilfred (Bill) Howard**, each of whom mentions having seen the other in recent years. **Ed** spent his working career in the utility industry and at the time of his retirement in 1973 was a vice-president of **Stone and Webster Management Consultants, Inc.** Thereafter he moved to Atlanta where

Inventor of the Year



Allen Latham, Jr.

I have a friend who may owe her life to Allen Latham, Jr., '30. My friend has ITP (idiopathic thrombocytopenic purpura), a close cousin to hemophilia, and she regularly has her platelet count checked. When the count is low, she is in danger of hemorrhaging. The remedy is a transfusion of platelets.

Twenty years ago, Latham invented the disposable plastic centrifuge bowl, which made not only possible but practical the separation of blood into its various components, such as red and white blood cells, platelets, and plasma.

For ITP sufferers, the Latham bowl made it possible to provide long-term treatment with platelets from one compatible donor, thereby avoiding the reactions that occurred when many donors were required.

For this and other innovations, Allen "Jack" Latham was honored as the 1987 New England Inventor of the Year during the 9th annual Inventors Weekend at the Boston Museum of Science early last February. Previous honorees include Charles Draper, '26, Harold Edgerton, '27, Henry Kloss, '53, Edwin Land, and An Wang.

After graduating from M.I.T. in me-

chanical engineering, Latham acquired a background in chemical engineering while working at DuPont. He went on to work with his boyhood friend Edwin Land at Polaroid Corp., where he became more knowledgeable about manufacturing processes. In the 1940s, Latham moved to Arthur D. Little, Inc., where he became involved in the design and manufacture of cryogenic (low temperature) equipment and led the formation of a subsidiary company, later known as Cryogenic Technology, Inc.

In the 1950s, Latham became aware, through the work of Edward J. Cohn of Harvard, of the need for improved blood processing systems, and by this time he had the background in engineering and high-technology to contribute to the field.

Researchers during this period worked long and hard trying to come up with the precise shape and construction of a bowl that would spin 5,000 times a minute to separate the blood components without damaging or contaminating the cells. Glass bowls were used, but they occasionally burst in the laboratory. Workable stainless steel bowls were designed, but the ideal was a disposable bowl that didn't have to be

he became president of South Eastern Utilities Co., a small holding company that operates half a dozen water and sewer systems in resort areas along the east coast. Since 1975 he has worked as an independent consultant for such operations. Having lived in six cities and travelled extensively during his career, he and his wife decided in 1978 to return to Petersburg, Va., his wife's home town, where they are now living. . . . Bill Howard has had a varied career as an advertising man, business consultant, and tax adviser. From 1962 to 1966 he worked for the U.S. Agency for International Development in Taiwan on the development of Taiwanese exports. The Howards now live in Fraser, Mich., where Bill is still active in small-business counselling and tax work. His proposed thought for today: "80 is a milepost, not a terminus."

As another coincidence, we have reports this month from Oliver Green and Irving Dow, who both live in Leisure World in Silver Spring, Md., and apparently meet at Kiwanis meetings from time to time. Irving's note brings the sad news that Lou Verveer died quite suddenly on December 16, 1986, only two weeks after I had received an acknowledgment of the birthday greeting I sent him when he turned 78 in November. Lou worked for many years as an insurance accountant and clerical specialist in Chicago and briefly in Hawaii. At the time of his retirement he was an "elderly housing specialist" for the U.S. Department of Housing and Urban Development in the midwest region. He and his wife Janet lived in Downers Grove, Ill., where they were both ac-

tive in hospital auxiliary work, meals-on-wheels, and a local driving corps for cancer patients and others needing transportation. In addition to Janet, Lou is survived by daughter Mary Jane Alexander, son Philip, and three grandchildren. . . . We also have at hand a notice that Daniel Walker died on November 18, 1986. Dan graduated from M.I.T. as an architectural engineer and spent most of his career working for the Government. At the beginning of World War II he took a Navy-sponsored course in naval architecture at M.I.T. and thereafter worked in this field. More particularly, he worked successively at the Boston Naval Shipyard, Bureau of Ships in Washington, and NAVSEC in nearby Maryland. At the time of his retirement in 1971, he was a mechanical and marine engineer at the Naval Ship Engineering Center. Upon retirement he and his wife Ruth, who survives him, moved to Sun City Center, Fla., where he was living at the time of his death.—Gordon K. Lister, Secretary, 294-B Heritage Village, Southbury, CT 06488

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John Swanton, assistant secretary and class agent, sends the following. "As most of you know, we have all been saddened recently by the loss of our class president, Dave Buchanan. He died last October after a very short illness—it is hard to realize because he was so active at our recent 55th reunion. After contacting all available class members who are or ever have been class

officers, as well as those who've been active in class committees, we have a unanimous response to declare **Claude Machen** our new president. Claude has been vice-president and treasurer for many years, serving the class faithfully all this time, and he is well known personally to many of us. Claude has talked with **Ben Steverman**, chairman of our 55th reunion, and Ben has agreed to be treasurer.

"Louise and I made a wintertime safari by car, away from New England snows, to Florida, visiting first our daughter in Georgia and then four classmates throughout Florida.

"On the way we stopped to see Helen and Ed Worden in Mt. Dora, and we can report that they look fine and in good health, well recovered from their unfortunate driving-home accident after the 55th reunion last June. They have a most attractive place on a large lake.

"From there we went southward to Nokomis on the Gulf Coast for a pleasant visit with Laura and John Olsen. They have recently acquired a delightful home that was built as the showplace for the Spanish Lakes Mobil Home Park. Then on we went to Englewood, where we stayed overnight with Lillian and Al Sims, again a delightful place, and here we were treated to a Jacuzzi whirlpool. I'm already figuring how I can put together something like it in Maine!

"From Al's we doubled back slightly to Osprey, where we had a nice visit with Jean and Claude Machen. They also have an attractive place, and right on the water. In the Washington area, we stopped and stayed overnight with Loretta (Mrs.

taken apart, cleaned, and reassembled after each use. It was a very complex job, says Douglas Surgenor, president of the Center for Blood Research in Boston, but Latham stuck with it.

The Latham bowl has played a key role in modern techniques for collecting, storing, and handling blood products, as well as contributing to the development of new therapies. The value of blood separation was first evident in World War II, when countless wounded soldiers in shock were saved by infusions of serum albumin. Since that time, there have been major advances in blood therapy. Now, toxic or disease-causing substances can be filtered from the bloodstream, platelets and other short-lived components can be collected for patients receiving chemotherapy, and experimental treatments developed—such as one in which latent “killer cells” are removed from a patient, activated in test tubes, and returned to the body to attack cancer cells.

At age 78, Latham holds 30 patents and is still engaged in research at Haemonetics Corp., Braintree, Mass., a company he founded that now has over 500 employees and annual sales in excess of \$40 million.—*Sandra Knight* □

Enio Persion, whom we hadn't seen since Enio's death two years ago. She keeps active with her church and Masonic work.

“Just before Christmas we saw Hester and **Ted Morrill** at their home in Amherst. Ted is now on oxygen regularly but remains very cheerful.”

Dick Ashenden says “March saw us on a four-week trip to China including five days on the Yangtze River. We had five weeks cruising the Maine Coast in our own sailboat including a visit to **John Swanton**. . . . **John Hutchins** writes, “I am now in my 12th year retirement as an emeritus professor in the Johnson School of Management at Cornell. This winter we are going to Australia to see some of the America's Cup races.” . . . **Jean Feld** of Flat Rock, N.C., reports that her father, **Clarence Feld, Jr.**, passed away on July 26, 1986.

Emmanuel Fournier died June 28, 1986. . . . **John Cleveland** died September 19, 1986.

A newspaper clipping reports the death of **Everett Swift** on the day before his 53rd wedding anniversary. Everett was a sales engineer for 26 years for the Foxborough Co. before he retired. . . . The *Salem Evening News* reports the death of **William J. Hallahan** who was treasurer, director, and vice-president of Fay, Spofford, and Thorndike Engineering Co. Our sincere condolences to the families.

It was a great pleasure to have **John Swanton** and his wife Louise drop in to see us a few days ago. . . . **Larry Barnard** sold his house and, last we heard was living with his daughter in Kennett Square, Pa. . . . **Fred Elser** sent a list of names

and call letters of ham radio operators. If anyone wants them, please drop me a line.—**Edwin S. Worden**, Secretary, P.O. Box 1241, Mount Dora, FL 32757; **John Swanton**, Assistant Secretary, George St., Newton, MA 02158

32 55th Reunion

On January 16 a very well attended committee meeting was held. Enthusiasm was high, and that augers well for a successful 55th reunion. **Don Brookfield** reports that 60 classmates responded and expressed their interest in coming. A special invitation was sent to widows encouraging them to come if they can. The program: Thursday, June 4, Pops Concert; Friday, June 5, dinner in a downtown restaurant featuring a comedienne—lecturer, Assistant Professor Joyce Anisman-Saltman; Saturday, June 6, a bus tour of new Boston and many other events to fill the three days. By now everyone must have received a detailed schedule.

Russell S. Robinson writes that after surviving some tough storms that occur in Mexico in the Gulf of California, he has finally come to terms with his advancing years and retired from the sea—at least as a skipper—and sold his yacht. He says “I'm back in the university as a graduate student in geophysics. But my math is so rusty now, I'm glad I'll never have to make a living in this game.” . . . **Carl H. Wahlstrom** responds to my plea for news: “I had an emergency colostomy last July with extensive peritonitis infection but managed to live through it at my age (78). Will get it reversed in a couple of weeks so I can be normal again. My wife, her sister, and I returned from a two-week cruise on the Norwegian ship *Sun Viking* to nine islands in the Lesser Antilles in the Caribbean Sea. Had a chance to speak the Norwegian language again with passengers and crew.” Thanks Carl! I'm sure your classmates join me in wishing you a rapid recovery in your reversal operation.

F. Rolf Morral writes that he and his wife Lillie attended elderhostel courses in Spain in September 1986. He presented to the Museo de Ripoll a historic landmark plaque concerning the making and shaping iron from the 11th century to the time of the development of the blast furnace. They met with many friends and family and then returned to Columbus, Ohio, in time to meet with more friends from Sweden.

James Robson called to say he is well and hopes to be at our 55th. He is very much interested in America's manufacturing position in the future. To compete with the Japanese, American engineers need to play a larger role than they do now. JUNE IS OUR 55TH.—Come on down—you'll be glad you did!—**Melvin Castleman**, Secretary, 163 Beach Bluff Ave., Swampscott, MA 01907

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My thanks to **George Bull** for taking care of these notes while I've been gallivanting. It looks as though I'll be staying put for a while now.

Walt Hofmann writes, “Greetings from Silicon Valley to fellow classmates. Not much of overwhelming interest to report. We (wife Edith and I) are in good health, celebrated our 50th wedding anniversary late last year, and continue a pleasant association with Stanford University on their fine golf course.

“We do a fair amount of interstate travel on the Pacific coast and southwestern territory, with occasional excursions into Mexico and Hawaii. I correspond with **Bill MacDonnell** from time to time, when he is between board meetings. Regards to all.”

Another item comes from **Jerome Raphael**, a faithful contributor to these notes. Jerry says, “1986 was my big year for writing. Six of us are producing a book on the landmark dams of the U.S., to be given to the 3000 delegates expected

at the 16th Congress on Large Dams in San Francisco in June 1988. My chapter was about concrete gravity dams, including Grand Coulee, Shasta, and New Croton, 25 dams altogether.”

The last one is from **Wilton Lindsey**: “Have sold my home in Bethesda, Md., and moved to a residential retirement center in Chapel Hill, N.C. which is called Carol Woods. My wife and I have just passed our 47th wedding anniversary. We still plan to spend winters in Fla.” It's ironic that I didn't catch up with this note before I started traveling for the holidays; I spent Christmas with my sister-in-law in Chapel Hill. It sounds, however, as though Wilton would not have been around then anyway.

I have three deaths to report. **John W. King** died on May 14, 1986, in Dixon, Ill., where he had been in the real estate business. . . . **Neil F. Putnam** of Nokomis, Fla., died April 11, 1986. . . . **William C. Schumacher** of Cherry Hill, N.J. died October 3, 1986. On behalf of the class, we extend our sympathy to the families of these classmates.

My own travels in 1986 wound up in mid-November when I returned from a 25-day Linblad tour of China. I had signed up on the basis of the enthusiasm of **Hank Backenstoss** and also on what **Norm Krim** had told me about a similar tour he and Bea had taken in 1985. It turned out to be all I had hoped for—a really great experience as long as you stay flexible (the Chinese Travel Service sometimes has to change itineraries at the last moment). The tour I took included a seven-day boat trip on the Yangtze River. I think anyone going to China would be foolish to miss out on this: we saw marvelous scenery, small Chinese villages and towns that seemed accessible only by the river, hence changed very little by recent years. Many of the standard tourist sights are quite stunning, e.g., the terra cotta soldiers at Xian and the Great Wall north of Beijing. One place we visited in the latter city was a motor factory, a large complex that produces, so we were told, 25 percent of all the 10-100 horse power motors manufactured in China. It was interesting, but what we saw seemed to represent U.S. practice of about forty years ago.

One of the nice parts of the trip was the chance to get together with our classmate **Wing Lem Wu** in Beijing. I got our national tour guide to do the telephoning, and I arranged from him to come in and have dinner with me. As things turned out, he also brought his 34-year-old daughter with him. She is a mechanical engineer and very pleasant; I think she understands some English but doesn't really speak it. Wing has finally retired from active teaching at the Beijing Institute of Aeronautics (he's now 78) but continues as a consultant on wind tunnels. Since my return, I've had a Christmas card from him. Just after I saw him he went to Canton for an appraisal meeting of a wind tunnel especially designed for testing the aerodynamic properties of buildings and structures (they must have heard about the John Hancock Building here in Boston). Wing had been acting as a consultant on its design and construction.—**Robert M. Franklin**, Secretary, P.O. Box 1147, 620 Satucket Rd., Brewster, MA 02631; **George G. Bull**, Assistant Secretary, 4601 N. Park Ave., Chevy Chase, MD 20815

35

The big news from **Sam Brown** is that he retired from the board of directors of the Brooklyn Union Gas Co. in February, 1986. Whenever the weather has been right he and Natalie have been out on the golf course (sometimes as much as three times per week). They made a four-week trip to Scandinavia last June which included an 11-day round trip on a mail boat up the Norwegian coast to the North Cape several hundred miles north of the Arctic Circle and only 1250 miles from the North Pole. After a cold and wet summer, which most of us had, they have been back in full swing in their many activities at Punta Gorda.

Please return photo to Lloyd Bergeson
Box N Norwell, Mass. 02051 with my card.



Readers with good memories will recall the saga of Lloyd Bergeson, '38, rescued from the North Atlantic in June 1980 when his sloop Cockatoo II capsize in heavy seas. Undeterred by his loss and close encounter with death, Bergeson began in 1981 to build Cockatoo II's successor, based on M.I.T. Museum drawings for a "shoal draft Buzzard's Bay 25" by Nathaniel Herreshoff, class of 1870. Tore Hund was launched by Bergeson at a community celebration late last summer from a

historic site near his home in Norwood, Mass.—the location of a famous colonial shipyard on the North River. The Tore Hund for whom the new sloop is named was Bergeson's "first Viking ancestor recorded in church records as a Christian," a resident of Bjarkoy, Norway. Bergeson remembers Bjarkoy as "the crown jewel in an incredibly beautiful archipelago of some 400 islands. . . . I can hardly wait to revisit those waters, preferably in Tore Hund," he writes.

Kenneth Young writes from South Pasadena, Fla.: "I have yet to understand why when we get closer to 75 we get more interested in what is going on with our classmates of '35. Anyway I have. I am also trying to do more in the M.I.T. Club of Tampa Bay. This year I have been selected to represent our section on the 1987 ballot for District #7. I have no allusions about my chances of being chosen but it is a start. I have enjoyed the 50-year book and contacted some of the fellows I remember. **Louis Fong** for one. I note you are starting to do something about our 55th now. Can't be too soon. Can I help in some way from here in Florida?" You said the right words, and will be contacted in the very near future by Bernie Nelson or someone from his committee. Ken continues: "Almost every year we make some kind of an extended trip to various parts of the world. Getting back to England last year for two months, we tried an International Elder Hostel covering England, Scotland and Wales. Later we spent a week in London and, from there, toured various places. We had been in Cornwall in '76, so it took us ten years to get back. Willie and I are signed up for an Elder Hostel in Medford, Ore., during their Shakespeare Festival in May. We are thinking of going in late summer to Scandinavia on the Coastwise ferries of Bergen Co. So why not plan now for Boston and the Cape for the 55th? **Louis Fong** is planning for it too. So if I can help" Ken's address is The Admiral #303, 7300 Sun Island Drive South, So. Pasadena, FL 33707. . . . A brief note arrived from George Morrisette: "I have been married 50 years and have two sons and two grandchildren."

I am sorry to report the deaths of some of our classmates: **Robert K. Kennedy** died October 10, 1986, in Tucson, Ariz., as reported by his widow, Helen, **Dello Russo Pergentino** died November 1, 1986, in Westfield, N.J., **Angelo W. Ghirardini** died November 9, 1986, in Winchester, Mass. He had been retired for 5 years after 50 years as owner of G. Angelo Fruit Co. of Chelsea, Mass., and the Twin State Fruit Co. of White River Junction. He was founder and past officer of the New England Frozen Food Association.

As for myself I spent last night in my new one bedroom apartment in Waltham's Senior Citizen Housing. It will take me some time to get used to all the space I now have, including a walk-in closet, after being cramped up in a single small room for two years. I shall delay the details of my part-time jobs until I reach the point where I have no letters to pass along to you, but I should at least tell you that I am up every morning, and I mean every, delivering 185 Boston Globes on Sundays and 135 the other days for the week for one of the part-timers. I needed the exercise what with three desk jobs and getting fat and lazy. I have lost 20 pounds since September and feel great!—**Allan Q. Mowatt**, Secretary, P.O. Box 524, Waltham, MA 02254

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More information from Christmas messages received or relayed by other classmates. . . . In August and December **Claxton Monro** arranged reunions of children and grandchildren from far

and wide, including Australia. Clax has had the great pleasure of baptizing his own grandchildren, and although retired after many years as rector of churches in New York and Texas, he continues to be very active in training lay people for religious activity.

The scholarship fund established in memory of **Wally Sylvester** by his family was reported in our January 1987 class news. Word now comes of another, substantial fund created by **Henry Johnson**. If this keeps on, we will come to be known as the scholarship class—and well we might, because we know so well how loans and scholarships kept many of us at the Institute in those depression years.

Let's toast the lives of **E. Hibbard Summersgill**, Course II, who passed on last December 14, and **John Rowan**, Course IX, who passed on April 30, 1986. John, from Canada, entered senior year from Ecole Polytechnique. His career was with Imperial Oil Ltd. in Ontario. In recent years he wintered in Clearwater, Fla. Hib was with duPont in Delaware and Rhode Island, and retired to Longmeadow, Mass., where he enjoyed ushering at the Tanglewood Music Festival. Over the years, he served the Institute and his community in various activities.

Congratulations to **Eli Grossman**, who received a Pewter Beaver award from the M.I.T. Club of Hartford last October (see *Technology Review*, February/March, p. MIT 11) for serving his "alma mater and community unstintingly."

When reading the 50th reunion biographies, I noticed a number of items which apparently never reached the secretary for mention in class notes. Perhaps we are reluctant to write of our own doings and accomplishments. If so, write of your classmates doings, from personal knowledge, news clippings, etc., and perhaps they will reciprocate. In any case, write or call—let us hear from you.

If our hopes are fulfilled, Phoebe and I soon will get to Wimbledon tennis and the Henley regatta, then go on to Germany to pick up a camper for touring. So, I am leaving it to **Pat Patterson** to write the notes in my absence. Please pick up the telephone (on Saturday it's cheap), and call him with your news.—**Frank Phillips**, Secretary, 901 Los Lovatos, Santa Fe, NM 87501; **James Patterson**, Assistant Secretary, 170 Broadway, Pleasantville, NY 10570, (914) 769-4171

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50th Reunion

Norman A. Birch and wife Elvie sold their house in S. Carver, Mass., and moved to Lakeland, Fla. . . .

Josiah S. Heal wrote Bob Thorson that Marion is quite ill and they will not be able to make the reunion. Our hopes and prayers are with them. . . . **Robert C. Glancy, Jr.**, writes, "I spent summer at our cottage in Meredith, N.H., as usual, but this was terminated prematurely by the death of uncle W.E. Glancy, '13. Spent Christmas with daughter in Stroudsburg, Pa., where our newly appointed colonel, daughter Carol from Wurtsmith A.F.B., joined us. Planning fifth year in A.A.R.P. tax counseling program." . . . **John B. Nugent** is busy and involved in local affairs in Braintree, Vt. . . . **Robert H. Thorson** writes, "I am fully retired December 31, 1986, and am trying to sort out papers."

I regret to report the death of **Samuel Noodleman** of 7239 Sandpoint Way, N.E., #302, Seattle, WA 98115. His son, Louis Noodleman, '71, writes, "I am sorry to have to tell you that my father died of leukemia on June 10, 1983, after a great struggle. At the time he was adjunct professor of electrical engineering at the University of Arizona. He was deeply involved in teaching and is sorely missed by students and faculty as well as by myself, my mother, and my sister, Laura. I am sure everyone who knew him is saddened by his death."

Dick Young, chairman of our 50th reunion, working with the M.I.T. Alumni Association and your class officers, has developed the following

list of '37 classmates for whom we have no address: **Edward A. Bullenham, Jr., Frank E. Carney, Jacob B. Cohen, Stanhope B. Ficke, Albert V. Finn, J. Robert Fischel, Newman V. Gates, Rafik G. Ghattas, Francis E. Gilbert, Myer Glott, Arnaldo F. Gomez, Walter Haight, Lawrence E. Hough, Leo J. Lappin, Walter J. Malbach, John W. Murray, John J. Noonan, Randolph A. Peers, Jr., Charles O. Pike, Willard D. Rand, Jr., John W. Sage, Yulin C. Shen, George A. Siegelman, Lawrence B. Steinhart, Harry C. Swan, Edward H. Thompson, Irving W. Tourtellot, Edward J. Vanderman, Albert L. Varrieur, Robert A. Vogler, Frederic H. Whitaker, Joseph F. Wiggins, Harold G. Zambell.** If anyone has any information, please drop Bob Thorson or me a note or card so we can notify everyone about our plans for the 50th reunion. Dick sent out a mailing on February 15, 1987. If you have not received it please write one of us or call me at (617) 396-2159 or Bob Thorson at (617) 729-0503.—**Lester M. Klashman**, Assistant Secretary, 289 Elm St., Apt. 71, Medford, MA 02155; **Robert H. Thorson**, Secretary, 66 Swan Rd., Winchester, MA 01890

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Howard Milius reports that he is still married to his wife Hope, whom he met in the spring of 1936 on the Harvard Bridge. They have three children and seven grandchildren. Still living in Cranston, N.J., Howie retired from Millmaster Onyx in 1981, since which time he has taken art courses and three computer courses at the local college. In order to develop his right brain, he is presently studying portrait painting.

Barney Oldfield also has seven grandchildren—the seventh, Jessica, was recently born in London, England. Barney and Norma still live in Brewster, Mass. Norma went to Tel Aviv in February to visit their daughter, Susan Gelman.

Word was received that **Wesley Gwatkin** passed away last October at his home in Toxaway, N.C. Wes had retired from Pratt and Whitney and is survived by his wife Helen. . . . Another death occurred last July—Mrs. **William McCullough**. Chemistry majors will remember her as Ruth Raftery. Ruth had been with Westinghouse in Baltimore.—**A.L. Bruneau, Jr.**, Secretary, 663 Riverview Dr., Chatham, MA 02633

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On behalf of appreciative classmates, we thank **Larry Lyons, Bill Pulver, and Fred Grant** for their letters and special news items.

Bill writes, "Only a little over two years to our 50th! How can that be? I always thought the guys in the red jackets were old." From Lakeville, Conn., Bill and Adie are busy with community activities, ice boating, skate sailing, and golf. A recent vacation included cruising bareboat near beautiful islands off Greece on a 36-foot sloop.

Fred Grant mailed a *Boston Globe* picture titled "Municipal Coverup." In the picture only the tips of Mt. Rainier and a Seattle skyscraper are visible above a vast white blanket of fog-cloud. If the *Globe* photographer were to be here beside me at about 150 feet above tidewater level, this sun-lit fifth of February, and look southeast, he would see Mt. Rainier unobscured by any clouds. It's inspiring.

Larry Lyons and daughter Carol toured ten cities in China. During the month-long trip they saw aspects of life in China, some universities, and industrial plants. A high-light was their three-day visit with Julie and **Charles Wang** who yet again demonstrated their thoughtful and cordial hospitality. The M.I.T. Club of Shanghai is active and has formal plans to increase M.I.T.'s endowment.

Jean and Bob Schmucker retired to Indianapolis from career activities in permanent magnet metallurgy. If Bob takes up the violin again, **Bob Touzalim, Aletta, Hilda**, and I would vote that the time

not be taken from barbecuing sessions, one of which we all enjoyed a few years ago on a summer evening in Illinois.

Warren Evans does volunteer community activities at Moraga, Calif., and travels overseas and around the U.S. in his Airstream RV.

Dave Lindberg was a delegate to the Pearl Harbor Survivors Association's 45th anniversary convention. Dave and Ellen participated in the parade on Kala-Kaua and the memorial service at the Punch Bowl Military Cemetery.

Bill Sears reports from St. Louis, "My brother Craig, '44, and I took a 14-day raft trip down the Colorado, through the Grand Canyon. Everyone should do it! At Long Beach, Calif., we had lunch with **Burky Kleinhof**."

Martin Lindenberg retired from textiles and accepted an appointment to teach an equal opportunity electronics program at New Bedford High School.

We are saddened by report of the death, at Bethesda, Md., of **Roger W. Swartz**. There were no details.—**Hal Seykota**, Secretary, 1701 Weatherswood Dr., NW, Gig Harbor, WA 98335

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The house organ of the Draper Laboratory recently carried a detailed review of the long career of Dr. **J. Halcombe "Hal" Laning**. After a few wartime years at the Watertown Arsenal, Hal returned to M.I.T. to get his doctorate, and also began his work at the Lab. He did some of the earliest work in computer programming, and later worked on the design and development of the Apollo computer. This was a critical part of the equipment that successfully landed our men on the moon. In his years at the Lab, Hal has held a variety of senior technical and administrative responsibilities in analysis, computation, computer development, and engineering applications of computers. Presently, Hal is head of the Automation Technology Department, where he expects to stay for at least another two years. It seems that retirement is not his immediate goal.

Among the other correspondents, the joy of retirement seems to be widespread. A note from **Robert W. Pratt** says, "Pam and I continue to enjoy very active retirement years here in Falmouth, including the M.I.T. Club of Cape Cod." . . . **Leonard W. Weaver** writes from Walpole, Mass., "Still enjoying retirement. Activities include working around house and yard, genealogical research, a modest amount of traveling, socializing with daughters and grandchildren (oldest a sophomore at Keene State College in N.H.), and singing in the chorus of the Neponset Choral Society, which I founded in 1949, and retired as director in 1982."

John Parnell of Yardley, Pa., noted that he is "retired and a consultant in product safety and regulatory affairs." **M. Arnold Copeland** states, "With retirement and acquisition of a home in Palm Coast, Fla., we are enjoying the best of both worlds, i.e., Florida and Pennsylvania! Boating is our favorite sport in Florida, made easier by a boat and dock to the rear of the house, with direct access to the Intracoastal Waterway. From northeast Florida, we've traveled to the Gulf of Mexico and the Keys. Three of our four daughters are married, and we can now visit eight grandchildren! Great! Isn't it?"

From Maitland, Fla., **Barrett L. Taft** tells us, "Sold my metals (lead) business last fall and am now semi-retired. Still doing a little engineering-consulting, mostly on construction of metal buildings. Hope everyone stays healthy until the 50th in 1990." We all agree with that, Barry!

Dr. Hyman Freedman has been fortunate. He lives in Wickford, R.I., and writes, "Pronounced 'cured' of cancer treated in 1982, when I retired. I play violin in the URI Symphony Orchestra and spend summers bumming around local waters in 32-foot sloop 'Sagattaire'."

Keep those notes coming and give us a preview of your activities, in many cases in retirement, be-

fore the grand 50th.—**Richard E. Gladstone**, Secretary, 1208 Greendale Ave., Needham, MA 02192

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Stanley Marple, Jr., sent this letter after he and wife Gladys attended our reunion: "I stayed in chemical engineering throughout my career and it was fun. I retired from Shell in 1985 after 41 years, the first half in research and development and the last 20 years in the central engineering department on the manufacturing side. I was a specialist in separation processes—both oil refining and chemical manufacturing—mostly heading a group of engineers in that area. The last couple of years they called me a consultant, which is quite an honor in the Shell Co. Most of my assignments were in Houston, Texas, but there were two stretches, totaling seven years, in New York City and one very enjoyable year at the Royal Dutch laboratories in Amsterdam. I was also active in the operation of Fractional Research, Inc., an industry-wide, non-profit research association, well known to chemical engineers. Gladys and I have two sons: Charles is a chemical engineer with Chevron in Pennsylvania, and Melwin is a salesman (and a good one) with a van line in Florida. They are both married, and Charles and his wife Diana are raising two daughters who are our pride and joy. We are spending the summer in Weymouth, Mass., but normally live in Houston, at 810 Soboda Ct. We would like to hear from any '41ers."

Sam Fry retired after 39 years at Boeing. He is still skiing, climbing, and wind-surfing in the beautiful Pacific Northwest. . . . **Robert S. Edwards** retired after many years at Sperry, in Long Island and more recently in Reston, Va. "My hobby for a number of years has been collecting and restoring antique clocks. I now spend two days a week in the clock collection of the Smithsonian Institute. We also enjoy traveling. We spent three weeks in France last year."

We held a mini-reunion with **Leona Zarsky** at Paul's Pizza in Falmouth, Cape Cod, to celebrate her husband Bud's recovery from a major operation and the completion of the remodeling of their Cape house. Your secretary very conveniently forgot to bring money.—**Joseph E. Dietzgen**, Box 790, Cotuit, MA 02635

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45th Reunion

Our 45th reunion is only a few weeks off—if you haven't made plans to be with us at the beautiful Woodstock Inn, phone **Dave Baltimore**, Kingstons, Pa., (717) 287-1780.

Bob Greene was recently nominated to run for the position of Village of Scarsdale trustee. He has been president of the Scarsdale Town Club and of the Scarsdale Democratic Club and is currently a member of the Scarsdale Planning Board. . . . **Milt Platt** retired and acquired the fanciest title we've seen in a while—senior director emeritus of Albany International Research Co. He is consulting with Albany on contract R&D administration and negotiation. Recently he has been getting into the use of composite materials, particularly in the medical and aerospace fields.

Ed Edmunds retired as president of Amerigas, Inc., a manufacturer and distributor of industrial gas, moved back to El Paso from Valley Forge, Pa., and is doing real estate development in New Mexico and in west Texas. Ed and Charlotte are doing a lot of traveling "particularly to tennis courts all around the world—both as spectators and participants (in the senior events)." . . .

George Illich retired from Abbott Laboratories several years ago and recently received an appointment as an alumnus of the National Ski Patrol in which he has been active for over 30 years. He continues his interest in the Boy Scouts—works in the handicapped scouting activities of the Northeast Illinois BSA Council.

Ann and **Bill Rote** are happily spending their winters in Sarasota and summers in Cotuit on Cape Cod. He reports that he plays trombone for the Senior Swingers, a dance (?) band in Sarasota, for the past several years. A quote (I think from Ann): "He has received many plaudits for finishing first" (i.e., ahead of the rest of the band). . . . **Bernie Levere** joins the ranks of old grandfathers with the arrival of a grandson last December. He and **Zelda** are traveling more than ever—USSR, Mongolia and China during the summer of 1986, with Rio for the winter carnival, plus Chile, Easter Island, and Antarctica in 1987. Bernie recently gave a very handsome gift to the Jewish National Fund, so you can look for some trees with the Levere name on them during your next trip to Israel.

Remember the dates: June 4 and 5 for Technology Day in Cambridge and then the weekend at the Woodstock Inn. It is not too early to get in training for our 50th! See you in June.—**Ken Rossett**, Secretary, 191 Albemarle Rd., White Plains, NY 10605

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Because I have no other news this month, and because it is such a good example of using the Alumni Association reply card, I am quoting in full the note received from **Raymond R. Richards**: "December 31, 1986, concludes a career of 40 years at Keohler Mfg. Co. in Marlborough, Mass., producer of the world's best miner's lamp. I will still have an association with Keohler as a director and consultant, but Randi and I are welcoming the freedom from commuting and deadlines that will allow us to pursue many deferred interests." Thanks, Ray, and the rest of you take note.—**Bob Rorschach**, Secretary, 2544 S. Norfolk, Tulsa, OK 74114

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Larry Biedenharn was visiting professor in the physics department at the University of Texas at Austin for the spring semester. We all appreciate the nice photos Larry took at the Williamsburg mini-reunion. . . . **Tom Carmody** has accepted the post of director of the Center for Chemical Process Safety. The Center is focusing on scientific and engineering practices that can prevent or mitigate episodic events involving the release of toxic and reactive materials. In the Center's first annual report, Tom writes that up until now there has not been a well-established, widely used engineering approach to the prevention of episodic events. The Center is working to provide chemical engineers and other interested parties with tools that can help them identify potentially hazardous situations in existing and new facilities and either eliminate these hazards or substantially reduce them. . . . **Bob Seaman** writes that he would like to hear from **Francis Holt**, **Maitland Baker**, **Al Vanderwyden**, and **Thor Thorsteinson**. Bob's address is P.O. Box 1951, Denver, CO 80201.

John Stevens writes that he retired in March 1986 from Tectron, where he was vice-president, technology development. He and Anna have moved from Lynnfield, Mass., to Reston, Va., where they are busy with more travel, learning the new area, and some limited consulting. . . . Although **Herb Cunningham** wrote last year that he was "too young to retire," he now is thinking that 1987 may be the year. . . . **Al Van Rennes** informs us that he is continuing in his fifth year as U.S. Technical Advisor to Indonesia's Minister of State for Research and Technology. His office is in the Agency for the Assessment and Application of Technology. Al says that this is an exciting assignment in a developing country that is rich in raw materials and is industrializing rapidly. With 170 million people, it is the fifth largest country in the world. Its span from East to West is greater than from New York to San Francisco. Al can be

reached through the U.S. Embassy in Jakarta.—**Co-secretaries: Louis Demarkles**, 53 Maugus Hill Rd., Wellesley, MA 02181; **Andrew Corry**, Box 310, W. Hyannisport, MA 02672

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Looking at that sea of shining faces in our reunion photo, I see some faces I can put names with and others I can't. Following are some I can identify. **Rube Samuels**, of Paramus, N.J., a short-time but memorable V-12 roomy, there with his wife Dee of 38 years, ended up with his B.S. in civil engineering from Dartmouth. After his active duty tour, he came back to get his M.S. at Harvard. He's currently chairman of the board of Thomas Crimmins Contracting Co. in New York, where he's been since 1950. Nice seeing you again, Rube. . . . **Walt Sauter** and his wife Leah ate late with us at the inn after the reception. His Course VI S.B., followed by an M.S. at Cornell, put him on the right track for the aerospace industry, where he's made notable contributions, most recently as vice-president of R&D with American Neulronics Corp. in Westlake Village, near UCLA. Three of his four kids graduated from UCLA, and the fourth went to San Jose State. But his most significant achievement (in my book) is having a home and acreage in Malibu. . . . **Bill Schield**, originally a Course II letterman, came back after his tour in "Pearl" to get another B.S. in Course XV. After a two-year career interruption, courtesy of a U.S. Navy Reserve recall for the Korean affair, Bill ended up with the Robert W. Baird brokerage in Milwaukee. There he and "Schatzie" (nee Charlotte) raised four kids, now grown and scattered around the planet, giving them an excuse for some serious globe trotting. Bill sounds happy-in-his-work, with no interest in retirement.

Clif Sibley and his wife Ann, Needham, Mass., are another smiling couple who enjoy their work—Ann with a 1986 summa cum laude Phi Beta Kappa from Boston College, where she teaches English. Clif designs vacuum coaters and furnaces as a consultant, after an interesting career with Norton Co., later Varian. They've put three boys and a girl through college and another one on the way. . . . **Ned Spencer** heads the Advanced Systems Department of MITRE's Air Transportation Division in McLean, Va., and lives in nearby Potomac, Md., with wife Irma, who's a sculptor. . . . **Dick Steele**, a rare Course XIV'er and another one of those lucky Korean travelers, got into consulting engineering early on, working in various disciplines either on his own or in conjunction with like-minded associates in the Washington, D.C. area. Now living in Columbia, Md., they've managed to raise six girls and three boys. Dick is heavily into health care delivery and financing on an international scale, which keeps life from getting dull.

A letter from **Bob Nelson**, now living/working in England near Cambridge, tells of his voyage aboard *QE II*. He and Marianne are enjoying the start of their five-year hitch with the Marconi Maritime Applied Research Laboratory, near a subsidiary of A.D. Little, of all places. His address and phone are available upon request. . . . **Ken Davis** joined Seidman & Seidman/BDO (in New York) as national director of Corporate financial services. Previously he had been senior vice-president with Advest Inc., and along the way had served as Assistant Secretary of Commerce for International Affairs.

More warm thanks go to prez-emeritus **Jim Goldstein** for his usual thoughtfulness in nudging some shy classmates into sending us their bio's. New prez **John Gunnarson** forwarded 12 pages worth to me along with a questionnaire generated by **Dan Cooper**. . . . **Glen Dorflinger**, our 45th reunion chairman, says he's received a good response from the above questionnaire.

A couple of sad notes. . . . **Louis Martin**, a good old course VI V-12er died last November 8 in York Harbor, Maine, where he had lived with

wife Mary since retiring from Intectron in 1969. In addition to Mary he is survived by two sons and two daughters. . . . A note from his son Maxcy III, who lives and works here in Denver, says his Dad, **Maxcy Daggett**, passed away January 6 in Dallas. I reviewed his book *High Sky, Low Sky* in this column a couple of years ago.

Blessings on all you nice guys.—**Jim Ray**, 2520 S. Ivanhoe Pl., Denver, CO 80222

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40th Reunion

COUNTING DOWN TO OUR 40th—not much time left to make your vote (\$\$\$) count toward the Class of '47 Professorship. Your check for this year and your pledge for each of the next five years will go a long way toward helping our class leave a permanent, continuing gift of teaching to all the classes to come.

Louis Stark retired from the Hughes Aircraft Co. in the spring of 1985, and he and his wife spent four months last winter in the Grenadines, West Indies, on his boat. . . . **Aaron Newman** took early retirement two years ago and has "retired" again by selling a small retail business he owned. He is now looking forward to starting a new venture in real estate. He says he is enjoying his "retirement." . . . From **Fred Howell**: "My wife of 34 years, Nancy, died several years ago. In August 1986, I married a vivacious redhead named Mary Row—lots of fun and a great shape. Playing tennis and enjoying workouts with Pauline Betz. Some short-term consulting with Wared Bank has taken us to China and Columbia."

Lee (Irving) Schwarz returned in November from a three-month teaching assignment in Wuhan, an industrial city of six million in central China, where he was lecturing at the invitation of the Chinese State Science and Technological Exchange. He says, "I taught work simplification, the management of improvements, to factory managers. I used as the basis of the course my 1947 M.I.T. thesis, 'Work Simplification in a Textile Plant.' This work included a 20-session course to be conducted in the factory. I had the opportunity to tour and take video of many factories in order to develop case studies for my students and was exposed to the best and the worst of their factory methods. Marge accompanied me and taught English and art during her stay. We may go back next fall to continue this much needed work."

Responses to the Alumni Information Update letter have brought us belated notice of the deaths of several classmates: **Sam Letulle** of Bay City, Tex., 1979; **Harold Hirsch**, with I.C. Industries, Amso Division, Abex Corp., Chicago, 1983; and **John Murphy**, an attorney with Xerox in Stamford, Conn., April 1986.

Two new parks appeared last fall in the Lechmere area, one in place of a building along the river, the other around the refurbished "Lechmere Canal," a stub of water curling in from the river toward Lechmere. The river-front park is complete with benches, trees, sculptures, and instant grass. Can't see the other as well, but I think it has a gazebo. . . . Thanks for your news. Keep it coming. As I used to write for the 5th grade poetry club, respectfully submitted,—**Virginia Grammer**, Secretary, 62 Sullivan St., Charlestown, MA 02129, (617) 241-7931, fax number: (617) 742-2497 (Please do be legible, especially on the FAX.)

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Harold Ottobri visited Professor Bill Greene, who remembered many '48 classmates, especially those who are in the Tech Show. He still gives lectures on both mythology and Shakespeare. Bill would appreciate a cheerful note: Apt. G305 North Hill Living Center, Needham, MA 02192. . . . **George Cooper** is in charge of the Scrap Vessel Trading Department at Bomar Resources, a New York-headquartered international commodi-

ties trading firm. They buy and sell about 30 ships a year, not as brokers but as owners. Some are salvage operations, such as the Fuji and Puerto Rican tankers that blew up at sea. Most of the ships are towed to Far East scrapyards, but occasionally they are sent on final voyages to the Far East with cargos. . . . **Bill Papian** celebrated his 70th birthday last July. . . . **Eph Sparrow** has received another prestigious award—the Worcester Reed Warner Medal from ASME in recognition of his superlative contributions and unparalleled productivity covering all facets of heat transfer and related aspects of fluid mechanics. He has published 550 papers and is the most cited mechanical engineer in the world according to the *Science Citation Index*.

Dick Baker is still operating his men's apparel manufacturing business from Broadway and 37th St. in New York City and is providing formalwear and uniforms to large hotels and related operations. Dick and his wife Joan have five children. Richard, Jr. is at Morgan Stanley following his B.S. from Boston College. Sally is in banking in Zurich following University of Vermont and the Sloan School. Karen is attractive and active. Julie is in high school and has been asked to interview at M.I.T. Mike at 12 is the family mascot and plays the flute and bassoon. Dick relaxes in his home workshop dreaming up inventions and machines. Joan grows fruit and vegetables in their garden. The family spends time in their home in Wellfleet.

Gerard Marlio completed 30 years in international banking and retired from the Bank of Boston. He has started his own international consulting practice. . . . **Eric Mollo Christensen** retired from his position at M.I.T. and is now chief of the Laboratory for Oceans at the NASA Goddard Space Flight Center in Greenbelt, Md. He commutes to work from Lexington, Mass. . . . **Charles Adams** married again in 1984. He and his wife Elaine have five children and one grandchild, age 1. . . . **Vaughn Beals** was elected to Simplicity Manufacturing's board of directors. Simplicity manufactures outdoor power equipment including riding mowers, lawn tractors, and snowthrowers. Vaughn is chairman and CEO of Harley-Davidson, a manufacturer of motorcycles.

Dan Fink continues as chairman, NASA Advisory Council. Recently the council issued an unusual public statement—that the U.S. had two choices, either expand the civilian space budget or decide consciously in which areas of science and technology to cede leadership. Normally the Advisory Council advises NASA directly on program and policy matters and has been reluctant to issue statements asking for more funds. . . . **Gardner Rogers** was elected secretary of Alpha Tau Omega Fraternity's High Council which functions as board of directors. Gardner was president of ATO's chapter at M.I.T. while he was a student. He has been active in fraternity affairs for many years. Gardner is director of corporate planning for the Consolidated Rail Corp. He spent a number of years in Australia as director and general manager of Fluor's railroad engineering and construction subsidiary.

Beverly and **Dave Freedman** completed another assignment as a volunteer consultant, this time for a bakery in Kingston, Jamaica. He helped them develop a product for export to the U.S., Canada, and Europe. He also improved utilization of their middle management personnel. Beverly volunteered at an institute for the blind, reading to the students and teaching Spanish. She needed Dave's help for one sixth-grader with a trig problem. Dave was astonished with how the boy plotted graphs using his finger along the sides of a newspaper to determine the x and y axis. Dave and Bev both recommend the volunteer experience to retired friends.

Bill Shempp has left Bell Aerospace-Texttron after 35 years in the aerospace technical management field. His new consulting firm is based on work as a visiting fellow at the Sloan School in 1978. The firm is Frontier Management Associates and will concentrate on innovation for small busi-

nesses. . . . **Thomas Pigford** continues on the faculty of the University of California at Berkeley in the Nuclear Engineering Department. He was a member of the U.S. Department of Energy's Expert Consultant Group on the reactor accident at Chernobyl. In 1985 the Institute of Chemical Engineers awarded him their Service to Society Award. . . . **Ed Kratochvil** is an experienced retiree after ten years. His wife Sue continues to work at the local hospital, and he manages their two acre "estate" as a country gentleman. He continues to learn a little more about horticulture and appreciates his Course VII training. They are active in the Episcopal Church in Pinehurst, N.C. Sue makes most of her clothes and some of Ed's. . . . **Bill Larkin** has retired in Oak Ridge, Tenn. He is in ill health and is handicapped.—**Marty Billett**, Secretary, 16 Greenwood Ave., Barrington, RI 02806

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Bob McConaughy has moved from Baldwin, Long Island, N.Y., to Melbourne, Fla., not because he has retired but because his company, Grumman Corp., moved down there from Bethpage, Long Island, and Bob went along.

According to a narrow strip of paper torn off a sheet by one of our gimlet-eyed clippings watchers, **John Anderegg** is the CEO and chairman of Dynamics Research Corp. in Wilmington, Mass. Twenty-five years ago, or thereabouts, when I was at Raytheon, John was helpful to me on the subject of optical encoders (if memory serves), and it is a pleasure to hear of him again.

The Boston Section of IEEE in its newsletter announced that **Bernard Steinberg** was to give a talk on November 17, 1986, at M.I.T.'s Lincoln Laboratory on the subject, "Adaptive Beamforming: What It Is, What It Is Good For, and How It Is Done." Steinberg has been a professor of electrical engineering since 1971 at the University of Pennsylvania's Moore School of Electrical Engineering and director of that school's Valley Forge Research Center. On top of that, and many other accomplishments covered in the announcement, he is the chairman and a founder of Interspec, Inc. in Philadelphia.

Bob Peterson retired in June 1986 after 25 years in the oil industry: 17 of them in Iran with the oil consortium, followed by eight with Phillips Petroleum in Houston. Among 14 activities which he listed in his yearbook write-up, Bob is still active in at least three. He writes: "Now enjoying windsurfing, tennis (no threat to McEnroe), and playing cello with a quartet."

Ray Frodey has retired as vice-president for research and quality control with Gerber Products Co., Fremont, Mich. He writes: "Arlene and I are actively pursuing nature photography and are achieving some recognition in exhibitions, competitions, and by publication in several magazines."

Ernesto Zapata writes from Bogota, Columbia: "After 25 years working on oil refining and petrochemicals, I'm dedicated to coffee oil extraction, soybean oil extraction, shrimps on captivity farms, and cattle farms." (Secretary's note: Ernesto, I never heard of a captivity farm for shrimp, and if I read your writing wrongly, I apologize.)

John Alger tells us that his is a three-generation Tech family since his father, Philip, graduated from the Institute in 1915 and his son, Montgomery, got his degree in 1977. John goes on to say that he is "working in Financial Services for GE Credit now, expecting to retire in New Hampshire at the end of 1987."

Jack Fogarty sent us a copy of his family's Christmas letter and at the bottom of a page of most interesting reading he modestly says: "Not much here of note. Still carrying on as fellow engineer with Westinghouse Advanced Technology Lab" (in Baltimore, Md.).—**Fletcher Eaton**, Secretary, 42 Perry Dr., Needham, MA 02192



Since last heard from (see July 1985, page B10), Janet Grosser, '53, has added freelance modeling to the list of her diversified career. Above: Janet models a design by Maryse of San Francisco, for Atelier CM of Los Altos, Calif.

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Sterling G. Brisbin has retired as managing partner of the consulting firm of Stearns and Wheeler to do part-time independent consulting, mainly involving litigation and arbitration of construction and sanitary engineering problems, plus management reviews of consulting design firms. Sterling has been successful in this work and has more time to enjoy golf, hunting, and woodworking. He makes his home in Cazenovia, N.Y. . . . **Nano Romaguera** reports that he is doing consulting work: appraisals of machinery and equipment, industrial properties, boiler inspections—a little bit of everything, he says. He works out of Puerto Rico. . . . In May 1986, **J. Murray Mitchell, Jr.**, retired from the National Oceanic and Atmospheric Administration as senior research climatologist, after 35 years of federal service. Murray is now returning to research on atmospheric tidal phenomena that was left in limbo for 25 years (since pre-computer days!) and, Murray says, it's about time somebody was working on this fascinating problem. He makes his home in Virginia.

Robert E. Wilson writes that he is retired from Exxon and now conducts business as an independent petroleum refinery consultant from his home in Altea (Alicante), Spain. . . . **Harry F. Raab, Jr.**, is in his 15th year as chief physicist of the Navy Nuclear Propulsion Directorate. Harry tells us he is recovering from a bout with lymphoma. During 12 weeks of chemotherapy he was able to continue working and the lymphoma appears to be gone. Harry says he has a lot to be thankful for. . . . **Loris M. Hailey, Jr.**, and his wife, Betty, are looking forward to Loris's retire-



Paul Cianci, '56 (left) and Ronald Massa, '56, class president and 30th reunion chairman extraordinaire, take a

smiling breather from the 30th reunion activities at Newport, R.I., early last June.

ment in 1987 after 11 years with Texas Instruments. His career also included nine years with General Dynamics, 11 years with Martin Marietta, and six years with L.T.V.—applying first analog and then digital computers to a variety of real-time systems. Loris has been struck often by the similarities between the career of an aerospace engineer and the life of an itinerant farm worker, constantly moving with the crops. Loris and his wife plan to travel a while, before they settle somewhere to establish a base for further travel. . . . **Albert Rand** has been named president and chief operating officer of the Dynamics Research Corp. in Wilmington, Mass. . . . We regret to report the death of **Howard F. Crombie**, who passed away on April 16, 1986.—**John T. McKenna, Jr.**, Secretary, 9 Hawthorne Pl., 10-H, Boston, MA 02114

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We hope you have received and returned the questionnaire on your preferences to our 40th reunion chairman, **Harold Glenzel**. If you have not received or perhaps misplaced the questionnaire, please request another copy from Harold at 237 Prospect St., Hingham, MA 02043. We really want and need your input.

Back from a recent four-week training and troubleshooting mission to the Hyundai Motor Co. in Ulsan, South Korea, **Roald "Rolly" Cann** writes that the people there are very kind and considerate. They are very interested in mutually beneficial long-term relationships rather than in some short-term advantage. Rolly feels that this is something we could learn from them. Rolly has been with the Bryant Grinder Corp. in Springfield, Vt., for almost 32 years and is currently their manager of research and development.

Recently promoted to senior vice-president for the commercial operations of EG&G, **Samuel Rubinovitz** will be moving to their corporate headquarters in Wellesley. Sam, who lives in Lexington, Mass., has a son, Robert, who is in the middle of a Ph.D. program in M.I.T.'s Economics Department. . . . Having retired to their dream

house at Cape Coral in Florida, **Curt Barker** and his wife are enjoying cruising through the waters of southwest Florida. . . . **William Krampert** has moved to the Tucson, Ariz., area and is continuing management consulting activities as a principal associate of Spectrum International Associates. They specialize in business planning, marketing, and international development. Bill made a point of adding, "Life is good!"

Having spent almost three years in Florida on assorted architecture related projects, **Jim Ballou** rejoined his wife Phyllis and "hung out his shingle" in Salem, Mass. On a limited basis, he is taking on small projects from his house. During the summer months, he is active with the Eastern Yacht Club Race committee. He is taking trips once or twice a year. Regretting having missed the reunion, Jim wishes to see any of our classmates who roam into the Salem area.

Handling the marketing of Dynamics Research Corp., a 30-year-old spin-off of the M.I.T. Draper Laboratory, **Peter Keller** lives in Wayland, Mass. Peter writes that he would have been at our reunion save for the fact that he travels at least every other year to Europe with his children in order to keep them bilingual. . . . **Stephen J. Chamberlin** writes that he is currently the general manager of engineering at the General Electric Jet Engine Plant in Lynn, Mass.

I received a warm letter from **Frank Koehler** telling of his retirement after 35 years of service with various domestic and international Exxon Corp. affiliates. His Exxon career included assignments in tanker operations and repair, industrial coatings marketing, solar energy marketing, aircraft refueling technical support, and international crude trading. Frank is living in Convent Station, N.J., and is currently retained by Exxon under a consulting contract.

His wife Beverly is enjoying her job with the Law Department of Exxon Co., Int., in nearby Florham Park, N.J. Frank and Beverly enjoy their limited amounts of spare time at their second home on the Cape in South Brewster, Mass. Frank is hoping to renew old friendships at our next reunion.

A number of you have already grasped the bait

and have been sent a copy of the class statistics and accompanying comments that we distributed at our 35th reunion. This treasure is in return for a few personal lines that I could print about you in our class notes. If you hurry, there are still a few copies left. Until they are exhausted, my offer holds.—**Martin N. Greenfield**, Secretary, 25 Darrell Dr., Randolph, MA 02368

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35th Reunion

This is the last occasion for me to remind you of our 35th reunion Memorial Day weekend in Newport, R.I. A remarkably able committee have worked hard to arrange a memorable event, but its success will result from those who come. I have no wish to belittle my own work, but keeping in touch only through class notes, while better than nothing, is like making love by telephone.

Even class notes would be nothing without the generosity of those who write to tell us how they are doing. . . . **Art Auer** writes, "It's hard to believe 35 years have gone by since graduation and that I have been in practice of vascular and general surgery in Saint Louis for 25 years. I am still working hard and not thinking of retirement yet. The challenge of cleaning out arteries and putting in new ones is still there. I still wear the beaver ring daily, but it is wearing thin. . . . **Nick Haritatos** has had an eventful year: "As a result of a reorganization, I am now in Chevron's new Engineering Technology Department, rather than in Chevron Research. Work continues to be exciting—I've worked on a platinum project in Montana, a gold project in Australia, and on chemicals like ethylene and polyethylene. Last July I visited Japan and saw palaces and temples in Kyoto, plus the huge Buddha in Nara. The food was great, except for the raw abalone we had at one meal.

"We had a German girl stay with us for a month last spring. Then in the summer my daughter stayed with the German girl's family for a month. Both girls had a great time."

Allen Tanner has had the satisfaction of finding old work newly appreciated: "For about 15 years after graduation, I studied radon and its movement in the ground. Hardly anyone cared! With the great interest in sources of indoor radon in the past two years, my work in the U.S. Geological Survey has drawn me back to radon and development of methods of appraising radon risk."

To carry the news from A to Z, **Stan Zisk** writes that he has a double career at Haystack Observatory. In planetary science/radio astronomy, his most recent work is making radar maps of the moon. Additionally, he's working in radio astronomy receiver development.—**Richard F. Lacey**, Secretary, 2340 Cowper St., Palo Alto, CA

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A few items of class news have found their way to Connecticut. Among them is a note from **Jim Hazard**, who reports that his daughter Peggy was married last September and his son Ray was wed in November. Since our daughter Mary is planning a wedding for this coming October, I can empathize with Jim. . . . From nearby Westport, Conn., **Rolf Kates** sends word that he has founded a new company to aid small manufacturing companies in automating their processes. It's called ELRO Associates, and through it, Rolf will analyze requirements, assist in implementing the automation, and provide follow-through and training for his client companies.

George Lamphere is, as he puts it, "currently" the president of Chas. H. Tompkins Co., general contractors, in Washington, D.C. George lives in Bethesda, Md. . . . **Jack Preschlack** writes from Lake Forest, Ill., that he was recently appointed to the M.I.T. Corporation Development committee: "Although alive and well, Tech needs our continuing support."—**Edwin G. Eigel, Jr.**, Secre-

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The news this month is plentiful and varied.

Charles Ladd III, professor of civil engineering at M.I.T., is the third M.I.T. '55 faculty member to be featured in this article. His most recent distinction was the delivery of the 1986 Karl Terzaghi Lecture at the American Society of Civil Engineers (ASCE) Convention in Boston last December. Since 1955, Charles has held various positions at M.I.T., including acting head of the Geotechnical Division, chairman of the Department of Civil Engineering Committee on Graduate Students, and member of the Graduate School Policy Committee. In addition to his current professorship, he is the director of M.I.T.'s Center for Scientific Excellence in Offshore Engineering and serves as graduate admission officer and member of the civil Engineering Department Council. Charles is also a registered professional engineer and has served as a visiting senior scientist for the Norwegian Geotechnical Institute and a visiting consultant with several engineering firms. He has authored and presented several papers and lectured extensively worldwide. Charles received numerous awards including ASCE's 1969 Walter L. Huber Civil Engineering Research Prize, the 1973 Croes Medal, and the 1976 Norman Medal for his paper, "New Design Procedure for Stability in Soft Clays." Charles makes his home in Concord, Mass.

Allen Tarbox notified us that he became president and CEO of Indian Head Data Services, Inc., the data processing and bank operations subsidiary of Indian Head Banks, Inc. He also was recently elected as director. Allen lives in Nashua, N.H. . . . **Robert Dyck** spent two months in Hungary last summer on a Fulbright Faculty Research Award studying urban and regional development policy. He will lead a study abroad program to Hungary this coming summer on the same topic. . . . **Martin Shooman** is a professor of electrical engineering and computer science at Polytechnic University (formerly Brooklyn Polytechnic) in Farmingdale, N.Y. He has been there for 27 years and has one-and-one-half years as teaching assistant and visiting professor at M.I.T. Martin will be publishing the second edition of his book *Probabilistic Reliability* in early 1987.

Philip Eisner retired from Exxon Research and Engineering Co. after 12 years of interesting research management. He states he is looking forward to a new career in decision analysis and R&D portfolio analysis with the Zimran Group. The firm is headquartered in San Francisco, but Philip will stay in New Jersey. He also notes his son Ned will be entering M.I.T. as a freshman in the fall. . . . **Dell Vernerde's** husband Jack will be retiring from ICI Americas, and Dell will begin teaching math again at Delaware Tech. She notes that she has had three rewarding volunteer jobs—tutoring with Literary Volunteers of America, rebuilding the pamphlet at the Wilmington Library, and leading school tours at Brandywine Creek State Park.

It's great to have plenty of news to write about, so keep it up.—**DuWayne J. Peterson, Jr.**, Co-secretary, 201 E. 79th St., New York, NY 10021; **Robert P. Greene**, Co-secretary, 37 Great Rock Rd., Sherborn, MA 01770

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Bruce B. Bredehoft is vice-president and director of research at Sit Investment Associates in Minneapolis, Minn. . . . **Jay H. Ball** is vice-president of operations for Hologic, Inc., a new medical instrumentation company in Waltham, Mass. . . . **Robert S. Carlson** has relocated to Hawaii, where he is visiting professor at the University of Hawaii specializing in international finance and in-



Will Reimann, Ken Ives, George Gifford, and Pete Peterson, '58, left to

right, relax after winning FISA Masters Championship in Bled, Yugoslavia.

ternational banking. . . . **Sigurd Hoyer-Ellefsen** has recently acquired control of Linton Roof Truss, Inc. in Delray Beach, Fla., and is operating the company as its chief executive officer. Sigurd now lives in Fort Lauderdale. . . . **Joe Goodwill** is the director of the Center for Metals Production at Carnegie Mellon University. Joe's son Ken is a junior at M.I.T. majoring in chemistry.

John L. Kelly left Hekimian Labs, Inc. in 1985, where he was vice-president of manufacturing, to open an automotive shop specializing in construction, preparation, and restoration of road racing cars. John is currently restoring an Allard, several Lotus's, an Elva, and a Porsche. This past fall he won his fourth national road racing championship at the SCAA "Runoffs" at Road Atlanta in the GT-3 class driving a Toyota Corolla GT-S. John lives in Gaithersburg, Md.

John W. Paterno is vice-president and general manager of the Advanced Systems Division of the Northrop Corp. and is responsible for the Advanced Technology Bomber (ATB) Program. . . . **Wendyl A. Ries, Jr.** received the Distinguished Service Award from Joseph G. Gavin, president of the Alumni Association, for "exceptional service to M.I.T. Clubs in Texas and New York, the M.I.T. Enterprise Forum of Texas, and the Alumni Association."

Robert N. Sawyer co-authored an article, "An Inventory Process for Determining Asbestos Control Needs and Costs," for the December 1986 issue of *Architecture* magazine. Robert is an independent consultant in industrial medicine and a principal in the firm of Entek Environmental and Technical Services in Troy, N.Y. . . . **Henry C. Valcour, Jr.** continues employment with Ionics, Inc. of Watertown, Mass., where he is European marketing manager; previously he served as business manager for Saudi Arabia—four-and-one-half years and lots of miles. . . . **Robert A. Holden** died unexpectedly last November. Robert practiced medicine in Shelburne, Vt., was a Robert Wood Johnson Scholar at Yale Medical School, assistant professor at the University of Connecticut Medical School, chief of medicine at New Britain Memorial Hospital, and medical director at Cham-

plain Valley Physicians Hospital in Plattsburgh, N.Y. He is survived by his wife, Margaret of Grand Isle, Vt., and four sons.—**George H. Brat-tin**, Secretary, 39 Bartlet St., Andover, MA 01810

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30th Reunion

Richard E. Mortensen presented a paper at the IFAC Symposium on Stochastic Control at Vilnius, U.S.S.R. He is the author of a textbook, *Random Signals and Systems*, which has just been published by John Wiley & Sons. . . . **Harry M. Johnson** writes: "After 14 years as an administrator, associate dean for the School of Business Administration at the University of Connecticut, I have returned to full-time teaching as a professor of finance. Our youngest daughter graduated from Clark University in May along with Nancy Currie, Jack Currie's daughter, and the bills are all paid."

Leo F. Hood retired from the Metropolitan Edison Co. in September 1986 as telecommunications engineering manager. He writes that he now has 13 grandchildren.

John P. Penhune has been made the general manager of the new Technology Research Group of Science Applications International Corp., headquartered in La Jolla, Calif. . . . **Richard D. Brandes**, who has held senior management and electronics engineering posts at Hughes Aircraft Co., has been appointed vice-president and group president of the company's Electro-Optical and Data Systems Group. Prior to his new position, Dick was a Hughes vice-president and assistant group executive at The Space and Communications Group. He has worked on radar systems design, air-to-air missile guidance and control systems, ballistic missile defense, and airborne fire control engineering.

Renata Cathou now heads up her own firm, Technical Evaluations, in Lexington, Mass., and provides technical management consulting in biotechnology. Additionally, she has joined SRC Associates of Park Ridge, N.J., a consulting consortium, which helps biotechnology and pharmaceutical companies to bring new products from

the R&D lab bench to full-scale production. Renata would be very interested to hear from any classmates in any of the above areas. . . . **R. Kenneth Boese** is in the private practice of general and vascular surgery in Glen Cove on Long Island, and he would like to say hello to all his old friends. . . . **Jay A. Holladay** is still on the technical staff at Jet Propulsion Laboratory in Pasadena. He's currently a systems engineer for the Space Flight Operations Center, an upgrade to our control center for deep space projects. Also, he served as first vice-president of the American Radio Relay League, the national organization of amateur radio operators.

David A. Appling retired from the army in 1983 and currently manages combat vehicle development programs for FMC Corp. in San Jose, Calif. David resides with his wife Caroline and sons, John and Tom, in Morgan Hill, Calif. . . . **Ralph Warburton**, professor at the Urban and Regional Planning Program, School of Architecture, at the University of Miami has been elected to fellow status in both the American Society of Civil Engineers and the Florida Engineering Society. . . . **David N. Freedman** now lives in Rockville, Md., and in September 1982 he was promoted to vice-president, corporate facilities for Giant Food, Inc., a leading food retailer serving the metropolitan Baltimore/Washington markets. He is also president of its subsidiary company, Giant Construction Co., Inc. . . . Since 1985, **Gerald L. Murphy** has been president of Levy Venture Management, Inc., Evanston, Ill., a chain of ten auto dealerships. Gerald is married to Joan (Lautenbach) of Chicago since 1959 and has two sons, 26 and 24. The Murphys live in Oak Brook, Ill., where Gerald has been a member of the M.I.T. Educational Council since 1961.

I am sorry to report the deaths of some of our classmates. **Norman L. Peterson** died April 17, 1986. At the time of his death he was chairman of the Department of Metallurgy and Mining Engineering at the University of Illinois. . . . **Harry M. Salesky** died early in 1985. He was vice-president of Rental Electronics, Inc. in Mountain View, Calif. . . . **William D. Pugh** died August 2, 1985. . . . **Laurence O. Friend** died September 15, 1986. He was manager of the Microwave Group, Motorola Inc. in Scottsdale, Ariz. . . . **James W. Conley** died March 19, 1986. He was president of Gateway Technical Services, Inc. in Scotia, N.Y.—**Vivian Warren**, Secretary, Anasville Rd., Somers, NY 10589

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Hello, sports fans! There is still lots of athletic competition at the masters level, as several members of our class can attest. **Pete Peterson** was a member of a four-man crew that recently won the FISA Masters Championship in Bled, Yugoslavia. (see p. MIT 25) For several years now, Pete and his teammates have been out on the Charles River early in the morning working towards this event. About their win Pete says: "It was a great trip and it was a great feeling to be able to bring home the championship." On the business side, Pete says that he's on his third, and probably best, start-up venture. The company, Digital Products, a manufacturer of office departmental computer networking equipment, has survived past the point where 95 percent of new ventures fail. And they're looking at good growth.

Herb Akavat says, "It takes tremendous will-power to prevent business from interfering with my triathlon training schedule. After I sold American Publishing Corp. about five years ago and ostensibly retired, I formed Ivory Tower Publishing Co. This new firm was intended to be just for fun, but unfortunately it has grown to be a very successful company. Nevertheless, I am still managing to compete in several events every year."

Malcolm Johnson is now chairman of the board of Foamseal, Inc., a compounder of urethane resins, in Oxford, Mich. He writes, "We have three boys: Brian, at the University of Michigan; Steve,

at Michigan State University; and Thomas, who is finishing high school in Flint. We live on Lake Lapeer and are active riparians as members of the Michigan Lake and Stream Association. I am also serving as editor of the Lake Lapeer newsletter." . . . Out in Denver, **Alfred Gough** has been promoted from a division vice-president to president of Manville Specialty Products Group at Manville's world headquarters in Denver. He says, "We've been in Denver three years and continue to look forward to the heavy flow of visiting friends, particularly during the skiing and summer hiking seasons."

Our mail bag contains a note from **John Connolly**: "For the past 14 years, I have been working in northern Virginia for Science Applications International Corp., a major consulting firm. Currently, I am vice-president for corporate development with special emphasis on DARPA and the SDI technologies and systems. . . . **Walter Johnson** reports that he is now entering his 17th year as a metallurgical consultant to general industry. He is living in Gloucester, Mass. . . . **Donald Isakson** is president and founder of Communications Controls, Inc. in Farmington, Conn. He joins the continuously swelling ranks of '58 entrepreneurs.

Among the recent recipients of ASTM's Award of Merit was **Sheldon Dean**, who is chief materials engineer at Air Products and Chemicals, Inc. He was honored for outstanding contributions in corrosion testing and development of standards. . . . **Toni Schuman** received the M.I.T. Lobdell Award this year and was cited for her creative leadership for the Educational Council, the M.I.T. Club of Southern California, AMITA, and the Alumni Association.

Be sure to drop me a line and tell me what competitive sports you're engaged in, so we can use it as a guide for planning the 30th reunion. Yes, it's that time already!—**Michael E. Brose**, Secretary, 534 East Broadway, South Boston, MA 02127

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The first item this month comes from Columbia University where Dr. **Lynn Sykes** is on the staff of the Lamont-Doherty Geological Observatory. He and another author, Dan Davis, published a fascinating article in the January issue of *Scientific American*. According to the authors the explosive force of Soviet strategic warheads has been generally overestimated, which seems to indicate that the Soviet Union has complied with treaty limits and been compelled to restrict warhead development as a result. They conclude that a rough overall parity in total destructive power has prevailed for the past decade between the two superpowers. I guess that's good news. Further honors came to Lynn when he and two other seismologists received the Federation of American Scientists Public Service Award for 1986. They were cited for their work in reviving the possibility of a nuclear test ban through the application of seismology.

Bob Broder is currently director of Voinovich-Monacelli Architects right there in Cambridge. He is involved in the design of correctional facilities and other high security projects. . . . **Glenn Zeiders** reports that he has left "Star Wars" after 13 years with the same company (which he co-founded). He has joined the commercial sector of chief scientist of AOI Systems, Inc., a manufacturer of automated printed circuit board inspectors, located in Lowell. . . . **David Pawliger** writes from sunny Gainesville that he is a physician in the private practice of internal medicine, hematology, and oncology.

The only classmate who took me up on my request for news over the holidays was **Dick Hall**. He and Yolanda sans college-attending sons Rikki and Jeff, have moved back to California. It turns out Aerospace Corp., where Dick is employed, closed its D.C. office. The Halls are in Manhattan Beach, ten minutes from LAX, living on (are you

ready for this?) Nantucket Place. Even native Californians miss the East.

And finally, a very moving letter from **John van Raalte** reporting the death of **Robert F. Webber**. Bob and John were very close friends from M.I.T. days until Bob succumbed to cancer last July. John describes a very special relationship that sustained both men during those final months of Bob's life. He relates, " . . . how important the contact with friends from M.I.T. and the fraternity (Lambda Chi Alpha) were to Bob in those terrifying days." He concludes, "We have lost a very special classmate, and I a great friend—Joyce and the two children deserve our warm sympathy and support."

As we enter this wonderful summer season, please try to have a pleasant and relaxing vacation; it's really worth it.—**Ron Stone**, Secretary, 116 Highgate Pl., Ithaca, NY 14850, (607) 257-2249

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Congratulations to **Rob White**, who has been appointed chief technical officer and vice-president for research and engineering at Control Data. Prior to his recent success at Control Data, he spent 14 years at Xerox and was professor of physics at Stanford. . . . **Charlie Garbarini** just celebrated his 10th year as president and owner of a chemical supply firm. He resides on the east side of Manhattan. . . . It must be the mile-high altitude in Colorado—**Robert Gold** has just finished 22 years of practicing medicine and is working towards a Master of Engineering Telecommunications degree, so he'll be putting on his graduation robe again in June 1988. . . . **Arthur Lipton** proudly reports that one son is at medical school in Boston and one son is an undergraduate at Yale. In order to write off his trips to his two prodigies, he's managing Kurzweil Computer Products. He lives in Palo Alto, Calif. . . . **Barry Karger** reports that he is now professor of analytical chemistry at Northeastern University. He recently enlightened his colleagues with: "High Performance Liquid Chromatography and Capillary Electrophoresis in Biopolymer Separation and Purification." You can write him if you would like a video.

Richard Rogers is chief operating officer and executive vice-president of GenRad, Inc. . . . If you're interested in flat belt continuously variable transmissions (CVT), ask **Ted Kraver** to send you a copy of the recent paper he presented at the Society of Automotive Engineers Exposition. Ted optimistically points out a favorable market survey and very few hurdles left to reaching success: industry forecasters indicate that there will be 1 million CVT models by 1990, and that CVT will be the transmission of choice by the year 2000. . . . **Al Krigman** writes, "Our class never seems to have notes. Apparently none of us is doing anything noteworthy. I'm certainly not, and I am pleased that this spirit has also been inculcated in the majority of my erstwhile brethren." I think the Philadelphia climate does that to people.—**E. Patrick Coady**, Secretary, 51 Louisiana Ave., Washington, DC 20001

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Corrections department. A note from **Adam Carley** enclosed January's column in which I said Alan Martin married Patricia Carley. Adam asks, "Who is Alan Martin and what's he doing with my wife?" Well, I really don't know. The fact is that Adam Carley married Patricia Martin in April 1986, and they live in Atkinson, N.H. . . . I got a nice note from **Terry Langendoen** last fall. I promptly misplaced it and came across it again a couple of weeks ago. Sorry, Terry. He wrote that he was disappointed about missing our 25th reunion last spring. His excuse was his directorship of the 53rd Linguistic Institute at City University of New York. That institute was an amalgam of training sessions in linguistics and related disci-

plines. The last time this sort of thing happened in New York was 1931. Terry is a professor of English at Brooklyn College but also holds positions in the linguistics and computer science departments. He wrote, "My reward for running the institute this year is a sabbatical leave in which I am working as a visiting scientist at the IBM Hawthorne Research Center, studying natural language programming. My son, David, graduated last June from Stuyvesant High School in New York and is now a freshman at the University of Virginia." . . . **Sandy Wagner** is also at IBM. He writes, "After 22 years in public education, I have consummated my three-year flirtation with IBM by joining the company to direct an effort to apply expert systems to employee training. I'm happy to report that my other attributes remain the same: wife—Linda; kids—Alice (16) and Mike (11); home—Menlo Park, Calif.; tennis—I get to everything but the form is terrible."

Frank Marra has lived in California for 13 years and loves it. "I have just been made president of OPUS Development Corp.," he writes. "I recently completed negotiations for nationwide distribution of our productivity software for the IBM PC. I still am with my original wife, Joy, and we celebrate our 20th wedding anniversary on October 15." . . . Another member of the California contingent, **Robert Vickery**, sent me an expanded description of his goings-on. He reports that he was a cofounder of a company called SPARTA, Inc., in 1979. "Since incorporation SPARTA has grown from two employees to 350, most of whom are members of our technical staff. SPARTA is one of five system architects of S.D.I., and we're very proud of our contribution to it and to other nationally significant programs. Several of our employees are M.I.T. alumni, including the executive vice-president (myself) and vice presidents **Bob Kinney** and **Dan Nowlan**, '62. Our excitement in building a high-quality company with high-quality people can't be matched. M.I.T. gave us a great start which we're now really beginning to appreciate." . . . **Ronald Wedland** is another Californian classmate. He works for the Electric Power Research Institute in Palo Alto, where he and his family live. His oldest son is a civil engineer working in Massachusetts. Another son and a daughter are at the University of Wisconsin Business School in Madison. . . . Also in Wisconsin—in Milwaukee—is **Warren Lederman**, who teaches in the mechanical engineering department of the Milwaukee School of Engineering. The Ledermans have lived in Milwaukee for 18 years. They have a son, Steven (9).

Moving east we arrive in Rochester, N.Y., where **Paul Schweitzer** is a professor of business administration at the University of Rochester. He says he is always glad to get together with classmates passing through Rochester. . . . In Newton, Mass., **Richard Mackler** is on sabbatical from Newton North High School. He is spending his time thus: "I arise at 5:00 a.m. to run, read *Thoreau's* Journal and study Feller's text on probability. Later it's tap dancing classes and listening to Schubert." . . . In South Hadley, Mass., **David Rundle** became the town's engineer last October. He is in charge of the town highway department, no mean task this snowy winter. He had been acting city engineer in Holyoke, Mass., for the last 10 years. David told the Holyoke town fathers that "he felt he needed a change and found the salary in South Hadley to be considerably higher than in Holyoke," according to *Springfield Daily News*. . . . **Richard Gilardi** is another government worker: he works for the feds. He writes, "I have been determining molecular structures for research going on (primarily) in government labs for about 20 years. The studies cover a wide range of materials, from the latest anti-malarial drugs to high energy propellant. I work in the lab of a recent Nobel laureate (Jerome Karle) and this year obtained the Navy Meritorious Civilian service award for my work." . . . Back at M.I.T., **David Wiley** has been working in the office of President Gray as an associate dean since 1972. He keeps busy as a member of the Commit-

tee of Concern at the First Parish in Lincoln, Mass., as a member of the Drumlin Farm Advisory Board (it's a model farm run by the Mass. Society for the Prevention of Cruelty to Animals), and on the City Mission Society Program. That wasn't enough so he started to play the cello a couple of years ago. Even that wasn't enough so he built a barn for his kid's two horses. Whew!

A couple of press releases came in the mail this month about **Bernie Goldhirsh**, class publisher. Bernie bought Dun and Bradstreet's magazine, *Dun's Business Month*, with a monthly circulation of over 300,000 (7,000 paid). Dun's joins Bernie's Inc. magazine (circulation over 600,000). The other release dealt with Bernie's membership on the Chivas Regal Young Entrepreneur Award selection panel. The \$5,000 award is to people under 40, so Bernie can't choose himself. . . . The Metropolitan Life company tells us that **Fred Haeusler** is assistant vice-president in the group national account department. Fred's been with Metropolitan since graduation, working his way up through the ranks. To keep busy he is on the Florham Park (N.J.) Board of Education and the M.I.T. Educational Council, and is treasurer of Pack Two of the Florham Park Cub Scouts.

I planned to continue reporting on the results of the questionnaire, but this month's mail was gratifyingly massive. I'll put off the report until next issue.—**Andrew Braun**, Secretary, 464 Heath St., Chestnut Hill, MA 02167

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Lovely to look at, delightful to hold. What am I talking about? Why mail, of course, lots of it—from all over the country. So let's get into it.

Tom Parr reports he is a geologist with The Analytic Sciences Corp. of Reading, Mass., specializing in remote sensing and digital image processing. Last summer he visited Skaergaard, Greenland, on an expedition for NASA. He is a NASA principal investigator in the Shuttle Imaging Radar program.

Steve Bernstein is still at Lincoln Lab's Communication Division. The group he leads operates all Lincoln-built communications satellites: "The last one was launched in December '86 and has not yet fallen out of the sky!" Steve, no offense intended, but I'm going to start walking around with my head upward, just in case.

Dennis Wood is head of the System Engineering Group, Flight Systems Technology Staff, Boeing Commercial Airplane Co. . . . **Richard Ludeman** is "doing as much sailing as possible—now teaching sailing also." I'm glad to see some of us are not involved in computers, airplanes and space ships, because we need a diversity of stories for our next get together (in May, 1988, plug, plug). **Richard Weiner** has just finished a term as president of the Philadelphia Bar Foundation, which is a charitable arm of the Bar Association. They raised \$150K, primarily for legal services for the indigent, elderly, and abused. Richard lives in Jenkintown, Pa.

William Jessiman reports that about a year ago he sold his share of a Cambridge, Mass., urban transportation consulting firm he headed, and is moving to Texas to start an airline operations research software and consulting firm connected with American Airlines. He likes living in Euless, near Dallas/Fort Worth, and reports, "the business prospects are super." What's all this I've been reading that Texas is in terrible shape because of the oil glut?

After 19 years in Palo Alto, **Joel Schindall** recently moved to San Diego to become president of Loral Data Systems. He and his wife Alice have two daughters, age 2 and 5: "The challenges of my new job, relocation, and family are keeping me busy!" . . . **Mike Merel** says he is currently executive vice-president of Economy Mechanical Industries of Illinois, a large Chicago-area mechanical construction company. He lives in Glencoe, Ill.

Dunwoody, Ga., is the home of **John Brach**,

who is now director of engineering for MARTA, the Atlanta transit authority. He is busy planning three rail extensions. His son Brian is a high school junior looking at colleges. Says John, "How time flies." *Je suis d'accord.*

Steve Kaufman was recently elected president and chief executive officer of Arrow Electronics of Long Island, N.Y. Steve had dinner with **Paul Richman** and his wife, and reports that Paul and his wife will soon be going to Japan for two years, to launch a Japanese affiliate for Paul's Standard Micro Systems, Inc., which is in semiconductors.

Elliott Bird says he "Finally ran the New York City marathon. Slower than the previous marathon (due to sciatica problems), but I finished (4 hours, 12 minutes)." Why do you guys have to keep embarrassing me? I was feeling good because I had finally done ten minutes on a stationary bicycle. Elliott consults with elementary schools, teaches at the C.W. Post campus of Long Island Univ. and spent five weeks in France last summer. Now Elliott is learning French, so he and his family can do France again.

I received a kind commendation from **Frank Model** (don't think I don't appreciate thoughtful remarks from you all, 'cause I do). He reports being back in R&D at Pall Corp., in Glen Cove, L.I., N.Y., with title of associate director. Frank's daughter Karyn is finishing her junior year in economics at SUNY Stony Brook. Frank ruminates on the remote possibility of Karyn being grad school roommate of Amy Bertin, daughter of **Mike Bertin**. Amy is an economics senior at Tech. Frank's son Daniel is a high school senior hoping to go to University of Michigan, and his wife Sue is assistant professor of sociology at University of Massachusetts in Amherst.—**Phil Marcus**, Secretary, 2617 Guilford Ave., Baltimore, MD 21218, (301) 889-3890

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Ivan Johnson writes from Pittsburgh that he is now with Carnegie Group, Inc. (C.G.I.), applying knowledge-based engineering to manufacturing problems. He is director of custom applications for production planning and control, with a focus on plant scheduling. Ivan was with Draper Lab before moving to C.G.I. in July 1986. There are two Johnson sons—Erik (7) and Kai (5). Recently, Ivan was visited for a few days by **Bill Hester**, who has lived and worked in New Zealand for about 10 years, applying "high technology" to large-scale government-operated civil engineering projects. . . . **Bob McKean** is chief financial officer of Thaler Financial Systems in Mountain View, Calif. . . . **Bruce Knobe** has changed jobs and is now managing one of the compiler departments at Prime Computer. . . . **Joshua Singer** was recently promoted to professor of physiology and pharmacology at the University of Massachusetts Medical School in Worcester.

Larry Rabiner has completed more than 21 years at A.T.&T. Bell Labs, where he is head of the Speech Research Department, doing research in automatic speech recognition. He is married, with three children—Sheri (16), Wendi (14), Joni (7). He plays racquetball and bridge regularly. Larry and I first met during Rush Week when he introduced me to all-night bridge playing, which I've given up. . . . **Larry Hendrickson** is our president-of-the-month. He was appointed president of Cellular Business Systems, a division of Cincinnati Bell Information Systems. It is a data software and processing company serving the cellular mobile telephone and paging industry. Larry lives in Evanston, Ill., with his partner and best friend, Betsy Umfrid. They are learning to survive the winter and enjoy the breadth of Chicago entertainment.

Next comes our legal news section: **Alan Gamse** was named chairperson of the Scope and Correlation Committee of the Tort and Insurance Practice section of the American Bar Association. He is a member of the Baltimore firm, Semmes,

Bowen and Semmes. . . . **Mark Lappin** is practicing patent law with Lahive and Cockfield in Boston. . . . Former class Secretary **Ron Gilman** is serving as the 1987 president of the Memphis and Shelby County Bar Association. Last year Ron honed his presidential skills by serving as president of the Society of Memphis Magicians.

We'll be travelling to Cambridge in June to attend Louise's 10th reunion at Harvard Business School—which is a roundabout way of getting to a reminder that our 25th reunion is only two years away. Hope you're planning to be there.—**Joe Kasper**, Secretary, 3502 Idaho Ave., N.W., Washington, DC 20016

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The Alumni Fund seems to have saved things up so that we'll have a gigantic May/June column. So fasten your seat belts, because this one will be longer than usual.

Steve Kaiser actually took pity on me for the short columns and sent a letter. He is working half-time for the Commonwealth of Massachusetts as an environmental analyst and traffic engineer, and is teaching two days a week at a Cambridge Catholic school, providing computer hardware, software, and instruction on a volunteer basis. Steve has been living in his three-decker in Cambridge since 1965 in reasonable comfort (which he distinguishes from luxury) and owns two 1959 Edsels. He admits to being thoroughly grossed-out by Yuppies; one of his career goals is to never become a vice-president. Steve also claims that he first heard the term "universal fudge factor" from me in a 5.01 lab. He says that little did he realize in 1961 how many consultants out there are so dependent on its application to so many varied situations.

Dave Cook writes that he has been head of the oncology department at Bay Medical Center and an assistant clinical professor of medicine at Michigan State University for several years. He became head of the Internal Medicine Department at Bay Medical Center in January of 1987. . . . Continuing with things medical, **Dick Tsien**, professor of physiology at Yale, where he has been since 1970, was presented a Javits Neuroscience Investigator Award for his distinguished record of contributions in neurological sciences. The award honors the late Senator Jacob K. Javits, and provides research support for seven years. The award recognizes his research in the role of calcium and calcium channels in neuronal function.

Another class medical personality, **Bill Brody**, has left Stanford to found Resonex, Inc., in order to develop a new magnetic resonance imaging machine for medicine. Bill is the president and CEO of Resonex. . . . And for our last class medical bulletin, **Jim MacMillan** has been elected a fellow at the American College of Cardiology. Jim is in private practice in Modesto, Calif.

Ed Burke writes that Data General has moved him and his family from North Carolina to Exeter, N.H. Ed is working at the new DG facility in Durham on development of "volume" products such as printers, terminals, and personal computers. According to Ed, Ann says that this is her next to last move—the last one will be to the cemetery. . . . **Jim Cheng** says that he has joined the MAC Group, a Cambridge general management consulting firm. Jim is specializing in financial services marketing. . . . **Steve Duerr** reports that after ten years in New Jersey with one small analytical research firm, he has completed the purchase of Metuchen Analytical, Inc., a consulting laboratory in the chemical analysis business. Steve is continuing metallurgical failure analysis work with Structure Probe, Inc., but says he can now pursue the entrepreneur "bug".

Consistent with this month's raft of career changes, **Lou Kleiman** recently became the chief executive officer of Edecon Corp., in Vienna, Va.—engineering design consultants specializing in the development of advanced automation systems for air traffic control. . . . **George Kinal** has taken

up employment as group leader in the services development department with the International Maritime Satellite Organization (INMARSAT). That change required George and the family to move to London in January. . . . **Linda Sharif** writes that her husband **Yarzan Sharif** is moving so fast that she and the children (Yasmeen, 14, and Sayf, 13) are having trouble keeping up with him. In 1985, Yaz was made vice-president and general manager of General Abrasives, a division of Dresser Industries in Niagara Falls. The family moved in August, 1986, but by then Yaz was transferred again. He's now president of the Harbison Walker Refractories Group of Dresser in Pittsburgh. . . . **Tom Perrone** writes that he left the techniques development laboratory of the National Weather Service in November, 1984, and has been working since then for Logicon, Inc., performing independent verification and validation of the emerging design of the F.A.A.'s Advanced Automation System. Tom published articles in the December, 1985, and January, 1986, editions of the *Monthly Weather Review* related to his research work in meteorology.

Art Bushkin reports that his company, Telemation Associations, has expanded to seven people. Art is continuing to study Japanese and has reached the stage where he can get around Tokyo in the native tongue. He says, he hasn't studied so hard since he left the Institute. . . . **Kim Kimerling** is head of the materials physics research department at Bell Laboratories, and is an adjunct professor of electronic materials in course III at M.I.T., where he teaches a graduate course (3.46) in electronic materials. Kim and Linda have two children: Rachel, who will enter Duke University in the Fall, and Sam, who is 15 and already taller than Kim. . . . **Henry Weil** is senior vice president and managing director of Pugh-Roberts Associates, Inc. of Cambridge. PRA is a Sloan School spin-off with most of its staff of thirty being Sloan graduates. The company provides management consulting, decision support systems, specialized software and training to "Fortune 500" clients in the United States and Europe. Henry has been particularly active in building PRA's rapidly-growing business in Europe. PRA develops System Dynamics models that are being widely used in contract dispute settlement in the shipbuilding, aerospace, and nuclear power industries. . . . **Eric Westerfeld** reports that he is still in the robot manufacturing business at Adept Technology. Eric runs the small electronics department in the company which is primarily committed to mechanical design, and has grown in three years from 30 to 220 people. . . . And **Richard Nathan** has been named general manager of the project management division of Battelle Memorial Institute.

Moving to the personal side of classmates' activities, **Alan Schutz** writes that last August he was married to Anna Smulowitz in a traditional Jewish ceremony in Newburyport, Mass. Anna is an actress, director, playwright, teacher, and child psychologist working with disturbed children. Anna and her son Aaron have joined Alan's four other children in Tewksbury, Mass. Alan is still working on ground probing radar at Geophysical Survey Systems in Hudson, N.H. He says one of their radars was used in Turkey to probe for Noah's ark in the foothills of Mt. Ararat. Alan also says that Jeraldo Rivera's crew paid them to survey Al Capone's tunnels before the live broadcast, and that they had said there was nothing there. . . . **Dan Diamond** writes that his son David recently completed a B.S. in Computer Science and Computational Linguistics at the University of New Hampshire. Dan reminds us that David was pretty swift with a flow-charting template at age 3. David has joined one of the VAX software groups at Digital Equipment in New Hampshire.

The **Martin Thomas** family is enjoying life in Boise, Idaho, where Martin is on the board of the Boise Philharmonic and the American Festival Ballet. Martin, too, has a son entering college next Fall. . . . **Suzy** and **Greg Schaffer** sent along

their annual Christmas letter with news of their varied activities. Greg is doing IC design for Maxim Integrated Products, his third Silicon Valley start-up. Greg has also been competing in triathlons (run, bike, horseback-ride) and ride and tie races. Last summer he took a climbing vacation in Czechoslovakia.

John Holdren writes that he finished a two-year term as chairman of the Federation of American Scientists in August, and is still chair of the U.S. National Committee for the Pugwash conferences on science and world affairs. John is also chairing a study for the Department of Energy on environmental, safety and economic aspects of magnetic fusion reactors. John says his son Craig is a junior at Cornell and his daughter Jill is a freshman at Berkeley. So he, Cheri, and their three cats have the house to themselves.

A better column I think, but feel free to write. By the time this is published I'm sure we'll be back to two notes a month.—**Steve Lipner**, Secretary, 6 Midland Road, Wellesley, MA 02181

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I received a note from **Joe Shaffery**, our previous class secretary, which contained lots of good advice for me and some notes from classmates. Thanks, Joe—still on the job. . . . A news release from Penn State announces the appointment of **Karl Kunz** as the new head of the Electrical Engineering Department. Karl was previously at Livermore Labs as a group leader in microwave and electromagnetic research. The rest of Karl's credits are too long to list, but Penn State is clearly glad to have him. . . . **Ralph Schmitt** is back in Los Angeles as general manager of a company in the machinery business. His older son will graduate from M.I.T. in June. . . . **Matt Fichtenbaum** reports that he works for GenRad in Concord, Mass., designing circuit board testers. He also plays square dance and Scandinavian music on a local radio program when not held captive by his daughter, Rachel (5).

Paula Jacobs is vice-president of development at Advanced Magnetics in Cambridge. . . . **Martin McGowan** is at A.T.&T. in Summit, N.J. . . . **Bert Forbes** and his wife Candace own Ziatech, a manufacturer of microcomputers, in San Luis Obispo, Calif. . . . **Michael Sutherland** is president and chief executive officer of Vector Graphic, in Thousand Oaks, Calif., having previously held the post of vice-president, engineering and development. . . . **Thomas Grover** has a new job as an engineer with the U.S. Geological Survey, building borehole radar and magneto-telluric instruments. . . . **Richard Gray** is working at Millipore and living in Brookline with his wife and two daughters. . . . **Berton Barrington** is "happy out here growing corn and soybeans in Minnesota."

Ken Browning is chief business officer at Illinois Wesleyan University, "enjoying the diversity and challenge." He also works for the M.I.T. Educational Council, and coaches youth baseball and soccer in his spare time. . . . **Roland Pittman** has been promoted to professor of physiology at the Medical College of Virginia in Richmond. . . . **Donald DeAngelis** is a senior scientist in the Environmental Sciences Division of Oak Ridge National Laboratory. He recently published his fourth book, "Positive Feedback in Natural Systems." . . . Another fourth book, this one from **Bob Poole**—*Unnatural Monopolies: The Case for Public Utility Deregulation*. It was a project of the Reason Foundation, a public policy think tank, which Bob heads. . . . Last spring, **Tom Scott** won his second Academy Award for best sound, on the film *Amadeus*. However, life as an independent sound engineer has had its ups and downs for Tom—lack of projects sent him back to a small computer company, until that folded. Now, happily, Tom is chief engineer of post production at LucasFilm, and back in the movie business.—**Jeff Kenton**, Secretary, 7 Hill Top Rd., Weston, MA 02193

If for some reason you have not made arrangements to attend our 20th Reunion (June 5-7) DO IT NOW! It will be a fun weekend: a Friday evening dinner dance at the Fogg Museum at Harvard; a Saturday afternoon clambake on Thomson's Island in the Boston Harbor; Saturday evening at the new M.I.T. boathouse; and Sunday afternoon at Fenway Park to see the still-undefeated Red Sox ("Reserved Grandstand" no less. I never even knew anyone who sat there!)

Bill Murray forwarded a fascinating *Smithsonian* magazine article entitled: "'Old Jearl' Will Do Anything to Stir an Interest in Physics." "Old Jearl" is none other than physicist **Jearl Walker**, award-winning science teacher at Cleveland State University. The several-page *Smithsonian* article describes his classroom style as "a blend of Mr. Wizard, Evel Knievel, and Saturday Night Live" and contains several entertaining photos of Jearl demonstrating the laws of physics, including plunging his bare hand into a container of molten lead, and lying shirtless on a bed of nails while a student stands on top of a spiked board on Jearl's chest. He entertains while he teaches. Jearl received an award from the American Association of Physics Teachers in 1981 as well as Cleveland State's Distinguished Faculty Award. He writes the column, "The Amateur Scientist," for *Scientific American* and is the author of a widely used physics text, *The Flying Circus of Physics with Answers*. Among his numerous other activities: he is an advisor to a children's science magazine and stars in an award-winning publications/broadcasting series, "Kinetic Carnival." Jearl apparently has discovered a secret source of unlimited energy and creativity.

Mary Jo and Harry Moser travel to Europe a few times each year to visit his Swiss parent company. Son Robert is a freshman at the University of California at Berkeley. . . . **Richard Rush** lives in Amesbury, Mass., with his wife Elizabeth and son Timothy. Richard is a lecturer in building systems integration in the Department of Architecture at M.I.T. and is technology editor of *Building Design and Construction Magazine*.

Christopher Reeve is vice-president of product development at Infocum Inc., an interactive fiction software company in Cambridge. . . . After 20 years **Bill Wilber** is still fighting Murphy and the Monster in the caverns of Alchemy at B.F. Goodrich. Bill's son Brian is off to college in the fall while his daughter Lyn will be entering high school.

Since October 1985 **George Starkschall**, wife, and two children, ages 4 and 2, have been living in the Houston area, where George is on the staff of M.D. Anderson Hospital and Tumor Institute. He heads up a group responsible for the development, care, and feeding of software and hardware used in treatment planning for radiation therapy. George finds it ironic to be so heavily involved in computers, considering that his lowest grade at M.I.T. was in 16.4, the introductory computer course. He recently conducted a choir in one of the Houston synagogues for High Holy Day services and looks forward to the time when his children will be old enough to join his wife in amateur musical theater productions. George is planning to attend our reunion.

Donald Oestreicher recently became director of application software at Evans and Sutherland Computer Division in Mountain View, Calif., where they are developing a high-performance large scale computer for scientific and engineering applications. . . . **Mike Crane** married Pamela Sotetani in 1984 and their son Gabriel was born last June. Mike has had his own management consulting business for the last five years and has been living in Berkeley, Calif., since 1983. . . . **Roy Gamse** reports that his son Nicky, age 4, and daughter Laura, age 2 are asking questions that M.I.T. didn't answer when we were there. Roy is vice-president of marketing for MCI Telecommunications Corp. in Washington, D.C., and his wife

Joyce gives tours of the National Gallery of Art as a part-time volunteer.

I was pleased to receive a letter from **Hank Heiberg**, who summarized the major events in the last 20 years of his life. After receiving his Ph.D. in mathematics from Ohio State University in 1971, Hank was assistant professor of mathematics at Virginia Wesleyan College for five years until 1977, and then occupied a similar position for two years at the U.S. Naval Academy. Since 1979, he has held various actuarial positions at Safeco Life Insurance Co. in Seattle, and this year he became an officer of the company. Last year Hank was named a fellow of the Society of Actuaries. Hank and his wife Karen, a registered nurse, have two children—their daughter Sonja is a freshman at the University of Puget Sound, and their son Charlie is a high school junior.

Bill Klecan is planning to attend our reunion, as are **Gerry Marandino** and his wife. . . . Betty and **Richard Graber** proudly announce the birth of their first child, Jonathan, on December 4, 1986. Richard is manager of network development for the U.S. House of Representatives. . . . **Lin Bernhardt Olsen** and **Rich Olsen**, '65, who live in Framingham and work at Digital Equipment Corp., report that they have "kept together for 17(!) years." They have been busy parenting two children, Kiri, age 12, and Elizabeth, age 7, and keep active with sailing, hiking, church, and retreats.

Daniel Hausrath was on sabbatical at the University of Chile in Santiago, Chile, from January to June, 1986. While there, he and his wife adopted a 3-year-old boy, Daniel Stites Hausrath, and also had the chance to see the workings of a military dictatorship: they are now back in Boise, Idaho. . . . **Tom McCarthy**, who is with Unisys (Burroughs-Sperry), recently visited Tokyo on business and found Japan to be a fascinating and friendly country. . . . **Frederick Hottes** writes that his life in Salt Lake City is gradually returning to a steady state with most unpacking completed, the landscaping for their new home finished, and the twins finally out of diapers. . . . **Marc Schulman** is a vice-president at Salomon Brothers, where he heads the technology group in the stock research department. . . . **John Fitz** is a project buyer for all C-E purchased material and services for waste-to-energy plants being built in Hawaii and Detroit, and also for the utility boiler being built for the Salt River Project in Arizona.

David Eisenhaure founded SatCon Technology Corp., an M.I.T./Draper Laboratory spin-off in Cambridge. SatCon is an acronym for satellite controls and brings various advanced electro-mechanical and electro-magnetic technologies into wider and more practical government and commercial use. Full-time operation of the company in East Cambridge has been achieved. David acts as president and treasurer and has a full-time technical support staff of five. . . . **Bob Karmann**, who has a dual career in psychology and computer science, writes that he recently developed his own psychotherapy, career development and training center in Whittier, Calif. To support his practice, Bob is writing a software system which he plans to market to other psychologists in private practice. He is planning to attend our 20th reunion. . . . **Don Berliner** provides micro-computer and decision systems support for Merck, Sharp, and Dohme, the company that was recently ranked "number one" in a *Fortune* magazine survey. Don lives in West Point, Pa., and does free-lance writing in his spare time. He recently wrote *Managing Your Hard Disk* for Que Corp.—**Jim Swanson**, Secretary, 878 Hoffman Terr., Los Altos, CA 94022.

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As we write this, we have just returned from a vacation sailing in the Grenadines, which, much to our pleasure and astonishment, coincided with the worst snowstorm in Washington in four years. Wish we could say we were smart enough

to have planned it.

Mike spent last fall teaching communications technology and policy back at the good ol' Tute, on a leave of absence from the FCC. It was a nice change of pace for him, and we both had a chance to reacquaint ourselves with the charms of Boston, but alas, it did set the column-writing back badly. Our apologies. Now that life is back to normal, at least as normal as it ever gets, we'll try to catch up.

We'll start off with a letter we received from **Leonard Schrank**: "Although the first section of *Technology Review* I always read is the alumni news, after 18 years it's about time I wrote it!" He goes on to relate that after the adventures of starting Dynamics Associates in Harvard Square, he and his partners successfully sold the company to Interactive Data Corp., a subsidiary of Chase Manhattan Bank. He is now working in London as IDC's vice-president, international. IDC offers securities information computer services based on the world's most comprehensive financial databases. He is kept busy traveling to their offices on the continent and in the Far East as well as with the upcoming Big Bang ("that's what they call financial deregulation over here—not to be confused with the prevailing theory"). His wife, Patricia, is French, and their two children, Alexander, 10, and Delfina, 7, are bilingual. In a postscript, Leonard notes "I cannot believe Allan Gottlieb is still writing his puzzle column, but that is another story about the TROLL days at M.I.T."

A number of job changes to report. **Paul Ware** left Polaroid Corp. after 14 years to join Kiddie Products, Inc. in Avon, Mass., as vice-president of quality assurance. He is still living in Stoughton and doing quite a bit of work in the American Society for Quality Control, in which he is vice-president of section affairs. . . . **Darryl Pomciter** left Kloss Video in September 1985, where he had been vice-president of marketing and sales (after ten years in video and audio equipment across the U.S. and around the world). He is currently working on several projects and looking for a company to run. . . . **Robin McGuire** has started a consulting company called Risk Engineering, Inc. in Golden, Colo. They specialize in applications of probability and statistics to a wide range of engineering problems. Business is good and they have four employees, including Gabriel Toro, (Ph.D. '84).

Bob Phair is returning to his Course VI roots. After five years as a faculty member in physiology at the Johns Hopkins School of Medicine, he is moving to the Department of Biomedical Engineering. . . . **Craig Kirkwood** was recently named acting dean of Arizona State University's College of Business. He had been chairman of the department of decision and information systems there. **James Pugh** has recently made the move to full-time consulting engineering by setting up his practice in Mineola, N.Y., just outside New York City. He is specializing in biomedical engineering, metallurgy, and materials science. His clients include major corporations, insurance companies, and private concerns. He has been appointed visiting professor at the Cooper Union School of Engineering and is continuing his research in biomedical engineering, metallurgy, and materials science. He has developed a new total hip prosthesis and is working on a new total knee prosthesis as well as specialized techniques for finite element stress analysis, impact kinematics, and microscopy. He lives with his wife Dona Bergin and son, York Bergin-Pugh, born May 6, 1984, in Port Jefferson, where all three engage in sailing, sport flying, and getting in and out of New York City with minimal effort. . . . By the time this appears, **Ron Rosen** and his wife will have left their shared position at the Marist College Computer Center to devote more time to their children, their own software development and consulting business, and (they hope) themselves.

Karla Karash has left the MBTA to join a new company, Ventana, formed by **David Peterson**. The president is Laura Peterson, '69. Karla re-

ports that she "loves the atmosphere of a very small firm." . . . **Rick Karash** is vice-president of financial services at Apex Management. . . .

David Coomber has been in the D.C. area for two years now and reports that he's "enjoying the weather." (That must have been before the recent snows!) His 1958 Mercedes 190SL is almost completely restored now, and he's looking forward to entering some car shows next year. . . .

Gary Anderson moved to Greensboro, N.C., in 1985, where he has his own real estate development and construction firm, engaged in industrial and commercial developments. . . . **James Hsia** has joined Candela Laser Corp. of Natick, Mass., as vice-president of R&D. The company went public in June 1986 and is entering the medical laser market with products for kidney stone management and treatment of skin vascular lesions. . . .

Platte Amstutz was recently named a vice-president at Continental Illinois Corp., where he serves with the International Banking Department in their European headquarters in London.

Michael DeManche reported some major changes. He got out of oceanography about six years ago and got married (again) last year. He is now manager of technology development at Coleco Industries in Hartford, Conn. He also designs toys, including Coleco's new Talking Wrinkles. He and his wife, Jan, live in the country outside Cheshire, Conn. . . . Also reporting major changes on the personal front is **Thomas Griswold**, who was divorced last April. "Best thing I could have done! But expensive!" He is now doing coal geology for the Energy Cabinet in Kentucky, where he has worked since 1975, but in other areas. Finally, he also just earned his second degree black belt in Kempo.

We are also pleased to report several recent honors bestowed on members of our class. **Samuel Cohen** was elected fellow of the American Physical Society for his "pioneering studies of impurity transport in plasmas and plasma-surface interactions," and **Gary Bjorklund** was elected fellow of the IEEE for "contributions to quantum electronics and nonlinear optics." Gary works for IBM in San Jose. . . . **Howard Robert Horvitz** recently received the Massachusetts General Hospital's prestigious Warren Triennial Prize, a 115-year-old award in the area of physiology, surgery, or pathological anatomy. This award is often called a predictor of the Nobel Prize, because eight of the 19 scientists who have received the honor since 1952 have gone on to become Nobel laureates. He was also recently appointed full professor in the Department of Biology at M.I.T.

Others report "no big changes." For example, **Paul Gluck** continues to practice OB/GYN in Miami and remain on the voluntary faculty of the University of Miami School of Medicine. He is currently chief of OB/GYN at Baptist Hospital of Miami, and president of the local OB/GYN Society. He lectures frequently and has just published an educational videotape dealing with medical liability problems. Along with his wife Joan, a practicing allergist, and their two children, he enjoys "the sun and fun of the outdoor life in Miami." This year, he reports, "I rode the emotional roller coaster with the Boston teams and was fortunate enough to attend the NBA finals but unfortunate enough to witness the World Series loss." . . .

Dave Ellis is practicing computer law and related areas (copyrights and trademarks, business and corporate law) in the St. Petersburg/Clearwater area. He just moved into new offices in Largo. He is also an M.I.T. educational counselor and reports an increase in the number and quality of M.I.T. applicants this year. His wife Sue is a clinical psychologist in private practice in Largo, and they have two girls, ages 6 and 3. They welcome calls from classmates. . . . **Karl Hella** has been an independent computer consultant specializing in microcomputers and database applications for the last three years. He enjoys the variety of people and problems. . . . **Kathleen and Bill Charles** report they are enjoying a balmy winter in the Bay area but hope for snow in the Sierras. They also report seeing Gregg Dieguez, '69, and his family

regularly.

David Kaye is currently serving as director of the Center for the Study of Law, Science, and Technology at Arizona State University. He also edited (with M. Aichin) a book, *Statistical Methods in Discrimination Litigation*, published by Marcel Dekker last August. . . . **Barry Mitnick** writes that as associate professor in the Graduate School of Business at the University of Pittsburgh, he is still doing research in organization theory and in regulation. The "theory of agency," of which he was one of the originators (in his dissertation in 1974), is fast becoming a major area of research and is a continued focus of his. He also notes: "Having wandered happily into social science as my academic area, I returned last year to some old interests. In Course VIII, I eventually fixed on X-ray astronomy. In the last year I've developed a strong interest in amateur astronomy as a hobby and went to Australia last April to photograph Halley's Comet. Although my 5-year-old daughter saw Halley's Comet as great excitement, she told me, 'Daddy, I think I like playing checkers even more than looking at the Ring Nebula.'" His wife Margy is very active working to get seat belts on school buses, making their school district one of the first in Pennsylvania to require them and "all three kids remain delightful and demanding."

Morry Markovitz manages accounts that trade in the stock index futures market and in "put" and "call" options on the S&P 500 stock index futures. . . . **Scott Merkel** is still trading on the Chicago Merc, which doesn't really exercise what he learned at Sloan, so he recently became a member of the board of directors of two entrepreneurial computer service companies. A few years ago, he went out to Arizona to play baseball with the old Cubs, which rekindled his interest so he now plays 1st base on a semi-pro team made up of guys 35 and older. But they compete against mostly 20-year-olds, so he says, "We don't win much!" He has also been working with several Chicago area Sloan graduates to start a Chicago chapter of the Sloan Club; anyone interested in joining should contact him; he's listed in the Arlington Heights, Ill., directory.

Ray Paret is still in the entertainment field, and consulting with The Doors in their 20th anniversary projects. He has also recently married. His wife's name is Shelly, and they have a new son, Joshua. . . . **Peter Groot** is still singing with SPEBSQSA. Their barbershop chorus placed seventh in district competition. . . . **Tessa Orellana Gardner** is running a research lab and also doing clinical infectious disease consultation as director of Pediatric Infectious Diseases at St. John's Mercy Medical Center in St. Louis. She and Morey have four kids (2, 4, 6 and 8), who keep them very busy. . . . **Richard Coppola** has been at the National Institute of Mental Health in Bethesda, Md., for several years now doing basic neuroscience research and developing neuroimaging techniques for studying functional brain activity. With Henry, age 6 and in first grade, and Rebecca, age 4, soon to follow, he is PTA president and looking for ways to develop hands-on science programs at the elementary school level. . . . **Daniel Green** is associate professor of pediatrics at the SUNY, Buffalo School of Medicine. He recently published a book *Diagnosis and Management of Malignant Tumors in Infants and Children* (Martinus-Nishoff, 1985). He married Lydia Ann Betz in January 1984, and their daughter, Amy Lynn, was born in June 1986.

We will finish catching up on old news next month, and thereafter hope to keep up with the flow.—**Gail and Mike Marcus**, 8026 Cypress Grove Ln., Cabin John, MD 20818

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I begin these notes with sad news announced by a letter from Maureen A. Basan: "Alumnus Melvyn Philip Basan of the Class of 1969, my husband and father of my children, died, silently in

the night of a heart attack, on October 25, 1986. He was 38 years old. Mel worked as a labor lawyer for the National Labor Relations Board in Chicago for 11 years. He was also an adjunct law professor at Kent Law School of the Illinois Institute of Technology, where he was a fine teacher and a wonderful asset to the legal profession. During the early 1970's he was an assistant to Dr. Herb Teager in his technological pursuits. Many, many people will long love and miss Melvyn—especially the children who loved their father greatly: Patricia L. Basan (9) and Bridget R. Basan, 8 months. We, the family of Mel Basan wish to thank the Chicago M.I.T. Club for their moral support and flowers during these trying times." Many of us had the opportunity to meet Mel for the last time at the class reunion in 1984. We'll miss him.

You have showered me with notes this month, so without further ado: **Hans W. Polzer** writes from Falls Church, Va., "I now work for Unisys Defense Systems, a new organization made up of the old System Development Corporation and similar groups from Sperry. My job is still chief engineer on a large navy intelligence computer system project, here in the D.C. area." . . . **Laurent V. Hodes** writes from Takoma Park, Md., "I took seven weeks off from doing research at HUD to go biking in France (Brittany and the Loire valley). Unfortunately, even my largest vacation since leaving M.I.T. eventually ended." . . . **Gary Hirsch** writes, "I continue to be a freelance/management consultant specializing in strategic planning for hospitals and medical schools. My wife Linda is a freelance photographer. We both work out of our home in Wayland, Mass. Our sons Adam (14) and Donald (9) keep busy with a variety of activities. We just had a visit from my former Burton House roommate, **Larry Viehland** ('69) and his wife **Kim Winters Viehland** ('69) and their sons." . . . And from our rocking, guitar-wielding, antenna designer, **Jerry Raines**, we get good news: "Jerry surrendered his bachelorhood to Beth Anne Silver, Cornell Class of 1979, a tall blonde from Rochester, N.Y., in August, 1986." . . . **L. Alan Kraning** informs us that he and his wife Katie Huddleson now have a son who was born August 17, 1986.

Robert Harrington writes, "Nearing my third anniversary as a venture capitalist and still enjoy working with entrepreneurial engineers, including many M.I.T. grads." O.K., Bob, send money! . . . **John D. Eldert, Jr.** writes from the Rockies, "This is my 12th year working in local government here in Aspen, Colo. I am currently the county manager. My wife Susan is a science teacher, and is on the local school board. We have two boys, 10 and 11, active in hockey, skiing, hiking, and sailing." Another dozen-year man, **Jeffrey E. Wieselthier**, writes: "This is the first time I've gotten around to writing in about a dozen years. I'm still living in Silver Spring, Md., with my wife, Ilene, and my daughter, Zemira, who will be 11 in January, 1987. I received my Ph.D. in electrical engineering from the University of Maryland in 1979, and shortly thereafter left the Naval Surface Weapons Center (where I had been working for 10 years, plus co-op time) to work at the Naval Research Laboratory in Washington, D.C., where I am doing research on communication networks." **Kathryn Kanarek James** writes, "I left Kansas City (home) and Ft. Leavenworth (work) in September and moved to Annandale, Va. I am working for the Institute for Defense Analysis in Alexandria. I recently attended my first M.I.T. Club meeting, where I was the only woman present. I am divorced and hope to meet lots of new people in the D.C. area."

Some, like myself, have forsaken D.C. . . . **Alan Ratner** writes, "After having lived in the Washington, D.C., area for the last five years, I recently moved to Harrogate, England with my English wife. Harrogate is a spa town on the edge of the Yorkshire Dales, site of James Herriot's *All Creatures Great and Small*. I've run into a few M.I.T.ers here; including classmate **Tom Stewart**, who will have moved to Harrogate by the time

this letter is printed." Space limitations and my endurance preclude a few more notes this time. I'll run them in the next issue. Thank God I'm a country boy! Whooo! Peace!—**Eugene F. Mallove**, Secretary, 183 Woodhill-Hooksett Rd., Bow, NH 03301

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Walter W. Schroeder III and his family moved from Chicago to Darien, Conn. He has joined First Boston Corp. as vice-president of mergers and acquisitions, with a focus on the energy and utility sectors. His boys are now 10 and 8. . . . **Richard Tavan** recently joined Teknekron Software Systems as director of engineering. He will be opening an office in Palo Alto, working on distributed systems. . . . **Bennie Ward** is associate professor in physics at the University of Tennessee in Knoxville. . . . **Dean Roller** has recently been appointed director of the Cardiovascular Laboratory and elected to the board of governors of Doctors' Hospital in Coral Gables, Fla. . . . **Janet Mertz**, after being confined to a hospital bed for 12 weeks with premature labor, gave birth to Daniel. . . . **Norman Payson** is chief executive officer of Healthsource, Inc., an insurance and H.M.O. holding company with H.M.O.s located throughout New England and in the southwest. . . . **Harry Ting** is the corporate officer in charge of marketing for Hillhaven's Nursing Homes, a division of National Medical Enterprises.

David A. Saar joined P.A. Technology as director of electronics engineering and is living in Princeton. . . . **David Thiel** has completed his sixth year as a consultant software engineer in the VMS development group working in VAX cluster systems for DEC. He and his family (wife Marilyn and their four children) live in Amherst, N.H. . . . **David Asbell** is currently working on microwave antennas at Georgia Tech Research Institute. Last summer he was involved with the U.S. Department of Energy Solar Thermal Program. He also successfully led a private boat expedition down the Grand Canyon. . . . **Antonio Vila** has moved to New Jersey and is a self-employed actuary. . . . **Stephen Cohen** is marketing manager for the Medical Supplies Division of Hewlett-Packard Medical Group in Andover. Before that, he spent three and a half years in Europe as European marketing manager.

Jon Fricker is associate professor of civil engineering at Purdue, became a father recently, and will spend part of 1987 in Karlsruhe, Germany, on sabbatical. . . . **Howard Hoffman** is facilities manager for Excel Industries in Chicago, after living in Northern California. He recently delivered a paper at the Water Pollution Control Federal National Conference. . . . **Jimmy Jackson** was in New York with Arthur Anderson as the officer in charge of firmwide application of analytical statistics and computer modeling, involving A.A.'s litigation and consulting practice. . . . **Arnold J. O'Donnell** has completed a master's degree in engineering administration at George Washington University and started his own construction company. He recently remarried. . . . **Frank Bender** is practicing medicine for Pulmonary and Critical Care in Escondido. . . . **Steven Carhart** recently married Martha Farmer, who is a research physiologist engaged in the development of artificial blood for emergency medicine at the Naval Research Laboratory in Washington, D.C. Steven continues his investment research service, focused on companies whose products or services improve the productivity of the U.S. economy.

Harry Feldman has moved to Virginia and joined C.S.C. as a computer scientist. . . . **Robert Berman** recently married Marilyn Lewis and now works for Lincoln Labs, where his spouse tracks satellites and he specializes in scientific computing. . . . **Steve Cooper** traveled to Australia to see Halley's Comet. He recently saw **Bob Weinreb** at his high school reunion. Steve is involved in eye care in San Diego. . . . **Linda Furrow** has moved to Vancouver and works for I.P. Sharp. She has



Stephen D. Umans, '70 (right), Ray Jackendoff, Ph.D.'69 (left), and Tom Stephenson, '70 (center), members of "No Dogs Allowed," perform at Eastman School of Music, University of Rochester. The wind trio celebrated their 20th anniversary with a Thursday noon concert at the M.I.T. Chapel where they debuted in the spring of 1967. They selected a program of Hayden, Ignaz Pleyel and Peter Schickele to mark the event.

When the group is not performing together or individually, Umans serves as a principal research engineer in the Department of Electrical Engineering and Computer Science at M.I.T.; Stephenson, manager of Advanced Computing Technology Department at The Analytic Sciences Corp., Reading, Mass.; and Jackendoff, professor of linguistics and chairman of the Linguistic Program and Brandeis University, Waltham, Mass.

recently worked on real-time data acquisition and control systems for power plants on the DEW line. She also travels to England and Cape Cod, and spent much time at Expo 1986. . . . **Thomas J. Garrity** has been named European area director for animal products at the Elanco Products Co. division of Lilly. He will be located in London. Previously, he was director of marketing planning for animal products in Indianapolis.—**Robert Vegeler**, Secretary, Beers, Mallerys, Backs, Salin and Larmore, 2200 Ft. Wayne Bldg., Ft. Wayne, IN 46802

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Al Solish is alive and well in Beverly Hills, now an M.D. and diplomate of the American Board of Ophthalmology. . . . **Bill Swedish** writes, "Linda and I have four children—Heniffer and Kristin (8), Margo (3), and Steven (1). My wife, Linda Griggs, is an attorney doing corporate securities and banking work with the Washington, D.C., firm of Morgan, Lewis and Bockius. I'm a lead engineer at MITRE Corp., helping to plan the operational testing of the F.A.A.'s new generation of air traffic control automation. Our lives are full, but satisfying." . . . **Howard B. Bluestein** writes, "spent a cool summer in Seattle, did lots of hiking; worked on my synoptic meteorology textbook at the University of Washington; now back at the University of Oklahoma in Norman—have been here over 10 years. . . . **Larry Kenneth Pleskot** writes, "I am at Northrop advanced systems division in Pic Rivera, Calif., as a senior technical specialist, and I'm working on problems involving first principles modeling of I.R. phenomenology for research and development applications. My wife and I just moved into a new house in Yuba Linda. A prototype elementary school is being built about five blocks away and should be an ideal educational environment for the children."

Alan Michael Cooper writes, "Liz and I are liv-

ing in Lynchburg, Va., where she practices pediatrics 'part time' (40-45 hours/week). I travel to mental health centers in the four contiguous counties as well as providing psychiatric care in Lynchburg. We have concerns about the possibility that we have developed an addiction to scuba diving. Less than a month after our return from Maui, the subtropics seem to be calling again." . . . **George Alvarez-Correa** has been at the World Bank as investment officer in charge of the fixed income, real estate, and venture capital portfolios of the staff retirement plan for the last three years. . . . **Ken Weisel** is the electric utility director of the City of Roseville, Calif., which is near Sacramento. . . . **Barry Levine** writes, "I am reminded this fall that at an M.I.T. mixer 18 years ago I met my future and current wife Judy. Acupuncture and Chinese medicine continue to amaze me. I am very happy with my mid-life career change."

Peter A. Stoll writes, "A business trip in Israel gave me a chance to spend a conventional day touring near the Dead Sea. I unwittingly sparked an unconventional end by failing to acquaint the bus driver with my destination until 30 miles past it. A night-time collective taxi ride in Israel was my enrichment. I only wish I had been able to understand the haggling between the bus driver/owner and the taxi driver. . . . **R. Dale Zellers** has a new job: still medical electronics but now monitoring anesthesia in O.R. . . . **Michael Kearns**, assistant professor of English at Ohio Wesleyan University, has won the 1986 Midwest Modern Language Association Book Award for his book, "Metaphors of Mind in Fiction and Psychology," which is the first thorough comparison of metaphors of the mind used in English-language novels and psychological texts during the 18th and 19th centuries. . . . **Robert A. Dennis** is a vice-president of Massachusetts Financial Services Co., America's oldest mutual fund organization.—**R. Hal Moorman**, P.O. Box 1808, Brenham, TX 77833

Lew Jester writes, "Relocated back to the San Francisco Bay area as assistant to the vice-president of Chevron Shipping Co. after three years in St. John, New Brunswick. Wife Suzanne and daughters—Larissa, 8, and Lindsay, 5—are glad to be back in the U.S., but we miss the seasons and the other Boston-like aspects of the East Coast." . . . **Michael Rowney's** second daughter, Julia was born in December 1985. He reports: "Last October, I left MCI for the entrepreneurial life. I opened the Washington office of Avenir Group, Inc., development bankers, and formed Hermitage Holding Co., as president and CEO. Our three Hermitage divisions manufacture quality gauze and disposable hospital products." . . . **Eric Ascoli** writes, "With wife Rebecca Grant, '71, have two girls, ages 3 and 6. This Christmas we moved into our new house which has been in construction for five years. This will be our first and last house project. We plan to travel the next few years."

From **Lawrence Baker**: "Still working at Exxon Production Research Co. in Houston as head of the applied math group, which is focusing its research on parallel computing. My wife Dorothy had a book published this year, *Mythic Masks in Self-Reflexive Poetry*, in the University of North Carolina Comparative Literature series. I see **Greg Shubin** from time to time, although he has left Exxon to head a math section at Boeing Computer Services in Seattle. . . . **Terrill Chang** and his wife Dawn welcomed Tyler Guy to their family last June 24, joining brothers Eric and Nathan. Dawn is "domestically engineering" while Terrill is a vice-president of SCS Engineers, a national solid and hazardous waste consulting firm. He manages the Bellevue Wash., office. . . . **Patty** and **Daniel Nadler** had a son, Zachary James, last November 21.

Ken Kampson opened a northern Virginia office for Covington & Burling with two other attorneys, where he is doing tax and corporate work and "would enjoy seeing anyone who wants to drop by." . . . **Norman Kohn** writes, "We just moved two blocks to a large house in Kenwood, Ill. The day after the closing, someone drove a truck through my fence. I've gotten quick lessons in outdoor construction and assorted other skills."

We had a particularly noteworthy contribution of news from the far eastern continent this month. **Carl Whittaker** has been living in Tokyo for the last year managing Bain & Co.'s Tokyo Office. . . . **Han Vo-Ta** has joined the Hong Leong Group, a major finance, real estate, and trading conglomerate, in Singapore as senior executive. He is also currently president of the Canadian Business Association and the Singapore Classical Guitar Society. . . . **Steve Perrenod** writes, "I'm living in Tokyo for a year as Asian market technical specialist for Alliant Computer Systems of Littleton. The Alliant FX/8 is the first computer to automatically parallelize usercode and is in the mini-supercomputer price and performance range. In early 1986, I married Yuriko Fukazawa of Numazu, Japan. After graduating, I got a Ph.D. in astronomy at Harvard and did two postdocs (Kitt Peak & Illinois) and then entered computing with Sohio Petroleum in San Francisco. I later spent three years with Cray Research. I will be returning to San Francisco with Alliant in mid-87."

Eugene Kroch observes, "As an M.I.T. educational counselor, who is also on the faculty at Penn, I am often asked about divided loyalties. Although I admire my colleagues here in West Philadelphia, I have no hesitation in recommending that my high schoolers choose M.I.T."

Your reunion committee has been diligently working on topping the great reunion that we had in 1982. If you haven't sent in a reservation, now's the time!—**Dick Fletcher**, Co-Secretary, 135 West St., Braintree, MA 02184

This issue brings a wealth of communications from the far reaches: **Daniel Vargas** writes from Bogota, Colombia. His thesis in 1972 dealt with exports of cut flowers as a means of economic growth in that country, and after 14 years in engineering and construction management, he is "back on the farm" "back on the farm" with HOSA, S.A., the world's largest producer of miniature carnations. On the side, Daniel is proud to report his reconquering of the Colombian national water skiing title. . . . **Ron Gittelsohn** is enjoying living in Nyon, Switzerland, along Lake Geneva, with wife Margrit and children Simone and Claude. His work at Reuters has been challenging, as he has recently been asked to manage a group of software and hardware development engineers. . . . **Alan Spoon** is in his fifth year with the *Washington Post*, as vice-president of marketing and finance. He will be assisting a master's student with his thesis this year by providing *Post* information and issues; the thesis is supervised by Alan's thesis-master, John Little.

Bob Byerly writes from Texas Tech, where he is still in the Math Department, that he is now an associate professor with tenure. . . . **Carl Rosenberg** notes that Graham-Rudman and N.I.H. have convinced him to join an H.M.O. He does not explain why. . . . **Joe Hadzima** has completed the third year of helping to teach a law course at the Sloan School on "The Manager's Legal Function." Though it's not easy to fit teaching in with his business law practice at Sullivan and Worcester in Boston, it is personally rewarding. . . . **Buddy Stern** is chief of gastroenterology at Shady Grove Adventist Hospital in the D.C. area, where he resides with wife Sarah and his two sons.

David Moylan writes that he is director of the Schuylkill Cancer Center in Pottsville, Pa. His wife Denise was expecting their second child at the time of his letter. David adds that he recently qualified for his pilot's license. . . . **Scott Cutler** is now senior director of software for Tandy Corp./Radio Shack. . . . **Dean Kross** is a cardiologist practicing in Pittsburgh. . . . **Tom Stagliano** is vice-president of his high school soccer referees' chapter. On the job front, Tom is still with Kaman as their West Coast rep. He is enjoying L.A. and wishing to see his old Boston friends.

Dustin Ordway recently joined the firm of Beveridge and Diamond at their New York office, which specializes in environmental issues. . . . **Lee Perrin** is practicing anesthesiology at St. Elizabeth's in Boston; he is teaching at Tufts medical school as well. On the side, he is an avid Mac user, applying computers to anesthesia and medicine. . . . **Richard Haas** is living in Shrewsbury, Mass., practicing internal medicine and endocrinology in Worcester. He and Ann have three children, Derek (5), Brian (3) and Andrea (1).

The letter prize for this issue goes to **Tom Lydon**, and deservedly so, since his letter is in the top five in total words in the 12 years (ulp) I've been doing this. Tom castigates fellow Theta Chi **Dennis Intravia** ("Ask him how many times he's written if we should 'get off our butts and write'"). Tom, Dennis, **Wes Grandmont**, and **Bill Gilling** still make up B.I.T. (Blytrumont Institute of Thinkology), spanning the disciplines of physics, meteorology, medicine, architecture, CAD, and several et ceteras. Tom wrote during a blizzard in Norwood, staying home from work expressly to write and counter Dennis's complaints about his wordless classmates. When not snowbound, he manages 20 software engineers at Raytheon in Bedford. His brother Paul, '90, joined Fiji ("the rat!"). Tom will have another try at populating Theta Chi, since he and Mary Paula are expecting their fourth in August to go with Mary Elizabeth (7), Tommy (6) and Eddie (3). He asks about his hockey teammates, and he asks for information on the 15th reunion. An easy answer for that: I have none.

Mateo Go has been elected a fellow of the American College of Cardiology, after M.D.ing at

Tulane. He is now affiliated with Santa Teresa Community Hospital in San Jose, Calif. . . . **Debra Judelson** is still in practice in Beverly Hills in cardiology and internal medicine, but spends every spare moment with daughters Dejah (3) and Anjuli (1) and husband A.J. Willmer, '75. They welcome calls from L.A. visitors. . . . **Robert Bjorge** was awarded a Melville Medal from the American Society of Mechanical Engineers. He is now with General Electric.

I promised I'd not say much if you would write, but I thought I'd mention that the kids are doing jolly: Eric (13) is skiing now, and at over 5 feet 6 inches he is now taller than I am. That's not saying much. J.R. (6) is enjoying kindergarten, reading up a storm and marveling at life sans tonsils. Write.—**Robert M.O. Sutton, Sr.**, Secretary, "Chapel Hill," 1302 Churchill Ct., Marshall, VA 22115

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Lots of news this month—thank you all for writing. . . . **Curt Thiem** is presently an engineering project manager in computer graphics software at Sun Microsystems in Mountain View, Calif. . . . **Edward M. Garber** was recently promoted to head of the Acoustic Wave Technology Section at TRW. For recreation, he continues to enjoy hiking and backpacking in California and the rest of the southwestern U.S. . . . **Jeff Schweiger** is currently assigned to the Command and Control Systems Division of the Office of the Chief of Naval Operations in Washington, D.C. He serves as program coordinator for Over-the-Horizon Targeting and Theater Mission Planning Center programs.

Fonda L. Thompson writes, "After living in Richland, Wash. (in the desert of Washington State), for eight years, I moved back to the Northeast in the fall of 1985. I'm presently working for Stone and Webster Engineering Corp. in Boston. In Richland, I was research engineer for Batelle, Pacific Northwest Laboratories, doing computer modeling of flow and contaminant transport in surface and ground water. For the last three years, I've been investigating the candidate high-level radioactive waste repository site in Deaf Smith County, Texas. It's nice to be back in Boston again!" . . . **Richard S. Withers** is immersed in the development of charge-coupled, ultrasonic, and superconductive signal-processing devices as associate leader of the Analog Device Technology Group at Lincoln Labs. He is also serving as Lincoln Labs' recruiter on the M.I.T. campus. Locally, he is helping oversee the construction of a commuter bikeway linking Cambridge, Arlington, Lexington, and Bedford.

Ken Deemer has this to say, "In June 1986, Inter Ven II, LP, a venture capital partnership, succeeded in raising \$51 million to be invested, primarily, in early stage technology companies in southern California and the Pacific Northwest. I am a general partner, along with four others. To unwind from the effort, my wife Candy and I spent three weeks trekking to 14,000 feet in the Nepal Himalayas." That must have been some high! . . . **Alan E. Levin** recently moved to the Atlanta area and has taken the position of associate professor of nuclear engineering at Georgia Tech, after spending the last year on loan from Oak Ridge National Lab to an electric power research institute office outside of Chicago. Says Alan, "My one major hobby continues to be wine tasting and collecting. My 'cellar' has grown to about 600 bottles." (So when are you having us over?)

David R. Martin is a management consultant with the Michael Allen Co. in Roycewayton, Conn. He's on the city council of the City of Stamford. . . . **Joseph D. Sacco** has been appointed acting chief of cardiology, Veterans Administration, in Albany, N.Y. . . . **David Dinhofer** writes, "I completed my training in internal medicine in 1984 and recently began another residency in radiology, which will be completed in 1989, at which time I will be joining my father in practice here in

Brooklyn." . . . **Charles J. Digate** is now senior vice-president of Lotus Development Corp. in Cambridge, Mass.

And this from my fellow lawyers. . . . **Michael S. Cucchisi** is a partner with Gibson, Dunn & Crutcher. He specializes in real estate development law and practices in Newport Beach, Calif. Some of the projects he has been supervising are the prestigious Vintage Club in Indian Wells, Calif., and the new 5,000-acre town of Rancho Santa Margarita, Calif. . . . Writes **Thomas Glen Leo**, "I attended law school upon graduating from M.I.T. and since 1978 have practiced with the law firm of Hill Wynne Troop and Mesinger in Los Angeles, of which I am now a partner. In June 1985, I married Suzie Beltran, and while thus far there are but the two of us, we do hope to contribute to the class of '09."

Congratulations to our classmates who already have contributed to future M.I.T. classes. **David Leep** and wife Peggy have a daughter, Rachel, who was 1 year old at the time of his writing. He has been an assistant professor of mathematics at the University of Kentucky since 1984. . . . **Kenneth S. Rumstay**, married to Sue Ellen McGrath, has one daughter, Rosanne, and is expecting a second child in mid-July. He is presently employed as professor of astronomy at the Valdosta State College. His research areas include star formation and galactic structure. . . . **Walter P. Lapatovich** writes, "I am now a principal member of the technical staff at GTE Laboratories and am continuing research on dense plasmas using laser spectroscopy. My major achievement this year, however, was witnessing the birth of my twin daughters. My wife Penny gave birth to two beautiful girls on September 21, 1986. Witnessing the Cæsarian delivery was a truly moving experience. Katherine and Elizabeth were the names chosen." . . . **Alan B. Lefkof** writes, "Ann and I are expecting our first child this month (December 1986). I am still busy as vice-president, marketing for GRID Systems Corp., a portable computer manufacturer.

So, how about the rest of you? Let me know what's new with you.—**Jennifer Gordon**, Secretary, c/o Pennie & Edmonds, 1155 Avenue of the Americas, New York, NY 10036, or 18 Montgomery Pl., Brooklyn, NY 11215

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We have a lot of news, thanks to the mails. **Fred Tsuchiya** is "still with MTS Systems Corp. in the Advanced Technology Development Group. He is now a project manager. . . . **Joe Albright** is also with MTS and lives down the street from me. He now has a second son, Grant, born July 14, 1986. Wife Kandis and son Karl (4) are doing well. Joe finished his M.B.A. at College of St. Thomas and is now doing some teaching at University of Minnesota—night classes in systems dynamics. . . . **Anthony "Tony" Lake** was promoted to senior manager of Technology Services for Peat Marwick, Mitchell & Co.'s St. Louis office. His wife gave birth to triplets (Josselyn, Joseph, and Nicholas) on December 14, 1985. He visited recently with **Keith Amundsen**, who went from DEC to ChipComm, and **Dennis Waldman**, whose wife just had a second baby and is still at HP."

David Lee is working as a diagnostic radiologist at St. Elizabeth's Hospital in Brighton, Mass. On a recent trip to D.C., he spent time with Jim Moody, '75, Sue Ann Hanson, '78, and Paul Denny, '78, all of whom appear quite happy," he reports. . . . **David Kew** writes: "Alive and well and working for a while at the Worcester Foundation in Shrewsbury, Mass. Grad school was fairly useless, except that I met my wife Laurie. And that lead to the joy of our lives, Abigail, now almost 3. The 'reunion' was enormously boring, and the food, atrocious. And we've seen more than enough about dealings in commodities." You secretary wishes to note at this juncture that this is the *only* complaint he has received in ten years about the brief discussion he has put in

about his activities. My clients trade of their own free will, using futures markets as a form of economics laboratory to test their ideas, which we call speculations.

Martin Brock reports: "I have received my S.M. from M.I.T. in electrical engineering and computer science—thesis on discrete mathematical aspects of network theory. I have also worked for a year at the IBM T.J. Watson Research Center, Yorktown Heights, N.Y., on Scratchpad II, a system for symbolic algebraic computation. I have also published my first mathematics paper in the October 1986 issue of *Mathematics Magazine*. Presently, I am very happily a full-time Ph.D. student in mathematics at City University of New York, mid-town Manhattan. I'm going into algebraic number theory and algebraic geometry. Hi to **Geoff Garner**, **Roy DeMeo**, and **George Oparah**." . . . **Robert "Bo" Fried** and wife Carla now have two children, Jason, 5, and Kyle, 1. Bo is a full-time physician at Wesley Long Hospital in Greensboro, N.C., and keeps an active interest in computer applications in medicine.

Neil Kaden has a new assignment at Bell Northern Research—manager of design support and interworking. He says, "I'm now responsible for support for several of Northern Telecom's product lines—Cellular Radio, OCC Long Distance Switches, the SL-100 PBX, and some of the Centrex, Autovon, and Military switches worldwide. It's keeping me on my toes!" . . . **Reynold Lewke** writes, "Spent the last several years in law, first in New York and then with the Legal Department at Sikorsky Aircraft. I've returned to the path of M.I.T. and am now a program manager for international derivatives for Sikorsky's UH-60 A BLACKHAWK. Very different, very interesting, and very challenging."

. . . **Richard Inz** reports: "David Charles Inz was born March 8, 1986. His big brother, Elliot (4), very much enjoys his new role, and Anita (Brown, '77) and I have our hands full with the two boys." . . . **Matt Breitenberg** is enjoying his three children (7,5,1) and line management in a basic industry as general manager of Bethlehem Steel's line pipe business." . . . **James Ryan** sends word: "On December 7, my third son, Patrick, was born eight weeks early but fortunately healthy. He's a great addition and fascinates his brothers Scott (6) and David (5)."

From **Jeffrey Held**: "It's been an interesting year. In April 1986 I married Mary Fairchild. I have been promoted to director, Systems Integration, at Network Strategies, Inc. Just closed on my second house." . . . And from **Zachary Levine**: "I'm going to be a visiting scientist at the Laboratory of Atomic and Solid State Physics of Cornell University, starting immediately (February 1987). I'm leaving the AT&T Engineering Research Center with the resolve not to do anything too useful ever again. I will be working on an ultra-rapid computational technique for the quantum mechanics of ordinary matter."

As for your secretary, his futures brokerage, Stalco Futures, Inc., continues to grow. The tremendous swings in, among other markets, foreign exchange, continue to create an urgent need to hedge on the part of multi-national corporations. We have rarely, by historical standards, seen so much intra-day and overnight volatility in the U.S. dollar. You can tell from the newspaper headlines discussing various emergency meetings and consultations between the Secretary of the Treasury and his overseas counterparts that the exchange rate movements, in some quarters (not mine) are thought to be getting out of hand. Connected to this have been the movements of the stock market, bonds, precious metals, and oil. So your secretary continues to be quite busy, as the volatility continues unabated. My wife, Rita, and daughter, Shana, continue to flourish. However, the constant volatility of the markets and the pressures of getting a new business off the ground do, at times, make me feel quite tired. But not too tired to do the column.

—**Arthur J. Carp**, Secretary, Stalco Futures, Inc., 225 West 34th St., S. 1705, New York, NY 10122, (212) 736-1960

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From **Herman Marshall**, who writes from Oakland, Calif.: "I'm working at the Space Sciences Lab, UC, Berkeley. I'm project astronomer for the satellite production, mostly in charge of the data analysis system and of modelling the instruments' performance. We're building an explorer-class satellite payload for observing in the extreme ultraviolet. We were hit hard by the Shuttle disaster, having to lay off programmers and engineers. Still, the good news is that I may be here for quite a few years (1991, 1995?)—because Berkeley is beautiful!" Herman adds, "It was funny to meet so many M.I.T. alums at a reunion of Simmons College grads." (His wife, Jenny, is one.)

A belated thanks to **Mitch Hollander** for his tacky postcard of Florida flamingos. Mitch was down in Miami (but "the sun was MIA"), vacationing from his work for DuPont (in Billerica, Mass.). Mitch lives in Brookline and is getting an M.B.A. part-time at B.U. . . . Also in the Boston area is **Martin Lurie**, who is happily married (to Anne) and living in Newton. Martin is still with IBM but is now with the Marketing Division. . . . Also still around the Hub is **Jack Little**, whom I saw at an IAP wine tasting class. Jack is living in the far suburbs (Acton?) and is president of a small software company.

A note from **Drahomir Lazar**, who writes to us from the Pacific Missile Test Center in Pt. Mugu, Calif.: "Just left my job as Phoenix project officer in Flight Test Division to become AMRAAM program officer. I'm doing program management work on the navy's share at PMTC of the joint program with the air force. I'm also working on two other programs—General Dynamics advanced missile system and the advanced air-to-air missile. Performing F-14 flight test work on aircraft software and missile systems including Phoenix, AMRAAM & Sparrow." . . . A note from **Jared Gould** in Houston announces: "I have forsaken the oil business for the Compaq Computer Corp. I'm looking after the testing of offshore Compaq 386 products."

New Professors Department. . . . **Jack Lissauer** has accepted an appointment as assistant professor of earth and space sciences at SUNY, Stony Brook on Long Island, N.Y. Jack will begin there this June. . . . Also teaching is **Peter Coffee**, part-time at Pepperdine Business School (where he got his M.B.A. in 1985). He writes: "My real job is now dominated by AI applications (especially their delivery on desktop systems)."

Nayyar Butt is happy to be back in White Plains, N.Y. (He lived in Dallas for several years.) Nayyar is still with IBM but now works out of their Manhattan office as a manager of insurance industry accounts. He says, "This is my first time working in Manhattan; it is exciting." . . . We also got a note from **Don Mellen**, who received an M.S. in computer science from Rutgers. He's now working on CAD tool development at AT&T Bell Labs.

Congratulations Department. . . . **Jasmine Topaz Frazier** was born to **Albert Frazier** and his wife Tamara on January 15 (8 lb., 6 oz.). . . . **Mazel tov** to **Scott Berger** and his wife Janice on their marriage (December 21).

Would You Buy a Used Car From This Man Department. . . . **Al Knauf**, former class officer, and one of our class's leading *honest* schysters, has now opened his own law practice in his hometown of Pittsford, N.Y. Al (who threw the party in Ann Arbor at which I met my wife) has a general practice, with a focus on environmental law.

Also moving back to his home town (Chicago) is **Larry Yablom**. Larry is now a vice president in the Corporate Finance Department at Rodman & Renshaw. He writes: "I recently visited the Institute, where I found a brand-new gym—too bad I couldn't have been born later." . . . A Booz Allen & Hamilton person, **Andy Stern**, has now made it to a principal in their strategy practice. He says, "I've been living in Chicago, during those times that I'm not living on airplanes."

Last, and least, there's me. Our apartment is rapidly becoming inundated with notes for Yuko's thesis (Sloan School). Ah, but the last tuition payment has been paid, and there's only one more semester to go. As for me, I'm still at the Planning Department of University Hospital in Boston, wreaking havoc in the Computer Center and learning the surprising things that must be done each day to keep a modern tertiary teaching hospital going.

Our 10th reunion is now just one year away. JUST ONE YEAR. Start thinking, planning, scheming about it now! It'll be twice as much fun if you bring your friends, so start your joint plans now for a vacation in Cambridge in early June 1988. If you have any thoughts as to how we can make our reunion more fun for you, send them to me at the address below. The funniest suggestions will be printed in this column.

Send me news, gossip, lies, boring postcards but especially ideas for our reunion.—**David S. Browne**, Secretary, 50 Follen St., No. 104, Cambridge, MA 02138

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David Westenberg is still a corporate associate at the law firm of Hale and Dorr in Boston, living in Wellesley with wife Nancy (Wellesley, '80). He writes, "We enjoyed an October weekend on Nantucket with **Doug Barnard** and his fiancée, Rose. 'Barney' is also a corporate attorney and is at Kirkland & Ellis in Chicago." . . . **Philip Stein** reports, "In August I finished my NIH postdoc at Harvard (11 years of college is a bit much!) and now work for E.R. Squibb & Sons in Princeton as a senior chemist." . . . **Bob Simms** is working in Detroit for EDS as the manager in charge of automation implementation at the General Motors Truck and Bus Plant in Pontiac, Mich. His second child, Richard Michael, was born in August.

Nivin Pei writes with the tragic news of **Mark Chelman's** death last October in a hiking accident. An item in the *Boston Globe* explained that Mark was hiking in New Hampshire's White Mountains with his sister Janet and her boyfriend. He had gone back to their car at dusk for a flashlight. Apparently, he slipped on a ledge in the dark and fell 50 feet to his death. Mark was an experience hiker who had recently returned from two weeks of camping in Colorado, Montana, and Wyoming. At the time of the accident, Mark was a chemical engineer with Westvaco in New York City. Our sincere sympathies go to Mark's sister Janet on her tragic loss.

Got a letter from Lisa Bosch, wife of **Greg Bosch**: "Greg received the Ph.D. in organic chemistry from Cornell University in January 1987 and moved back to the Kansas City area to work for Chemsyn Science Laboratories, a division of Eagle-Picher Industries. Our second child, Emily, was born in November 1986, in the midst of thesis-writing. She joins an older sister, Katie, now 3."

Kelly Hartshorn writes, "Happy to have a 'new' addition to our family. Matthew was born on June 29, 1985, just in time for our move to California with Chevron. California is a real haven for M.I.T. alumni!" . . . **Michelle Robbin** is enjoying her first year of radiology residency at UCSF after completing her internship in internal medicine at Children's Hospital of San Francisco. Meanwhile, husband **Tim Kraft** is enjoying postdoctoral retinal research at Stanford. Michelle reports, "We just bought a house in San Bruno and are finally beginning to miss the snow after two California winters!" . . . **Robert Drescher** is still at Rolm/IBM and was promoted to manager, voice applications marketing.

Eyad Abed received a 1987 NSF Presidential Young Investigator Award, which will provide up to five years of research support for his work in nonlinear control at the Electrical Engineering Department of the University of Maryland in College Park. . . . **David Soule** is a production manager at American Cyanamid's Niagara Falls plant (Can-

ada, that is). This past summer he bought a sailboat and spent most of his free time on Lake Ontario. . . . My fellow Wharton alum **Richard Gray** writes, "On December 1, I started my fourth job with Amoco in four years since graduating from Wharton. Now I'm doing project/acquisition evaluation in the Louisiana exploration and production region and living in New Orleans." . . . **Jonathan Bernays** reports, "After three years at Boeing, I am moving back to Boston, joining Lincoln Labs as a staff member, and getting married in March." Obviously a man who thrives on change.

Bonnie Mason writes "We have purchased a home (at last) in the wilds of New Hampshire. I am still at Wang but in a new position—marketing technical support for the Federal Systems Division. My husband, Al Chock, '78, is working up at Seabrook as the engineering software supervisor. We love our new home and defy anyone to come up with another one half as cozy! (Good thing, too, since it gets mighty cold up here!)" . . . **Bruce Wrobel** says, "Currently in last year of two-year employment contract as vice president with the French firm, Sithe Energies U.S.A., after their acquisition of Mitex, Inc. I invite everyone to visit me and **David Tohir** at the Baja, a dance club in New York City at 71st and Columbus, of which we are both part owners. Tohir, a vice president of corporate finance at Hutton, also engineered the sale of Mitex to Sithe Energies for myself, Bill Fowler, '81, and Mike La Row, '81."

. . . **Sow Chu** has joined the Philips Research Lab in Eindhoven, The Netherlands, and is contributing to the IC design center's Submicron Technology Program. In his spare time, Sow travels and learns the Dutch lifestyle and European languages. . . . **Elaine Imoto** is in her first year of a three-year pulmonary fellowship at Stanford Hospital and is living in San Francisco.

Brian Wibecan reports: "My wife, Nancy Levoy, '81, finished her Ph.D. in materials science this past summer, and we both got jobs with duPont and moved to Wilmington, Dela. We bought a house and two cars, and for the first time in my life I am driving to work. I work in duPont's Information Systems Department doing technical support and performance analysis on IBM VM machines, and I do some system management for the VAX group part-time. Wilmington is a great place to live; we're really enjoying it. M.I.T. folk in the Delaware Valley are invited to look us up." . . . **Robert Scott Stall** finished his residency in internal medicine at SUNY Buffalo in June 1986. He began a fellowship in geriatric medicine at VA Medical Center in Buffalo in July. He is looking for applications of high technology in health care for the elderly.

Brad Miller is a researcher for the University of Rochester Computer Science Department, where he got his M.S. in February 1986 and where he's continuing to work part-time on a Ph.D. . . .

Laura Lau-Peterson recently joined the R&D staff at GTE Data Services in Tampa, Fla., and will be collaborating in the development of an expert system for voice and data network design. . . . **Audrey Greenhill Lones** dropped a line from Singapore, where she and husband **Paul Lones** now live. She says, "Paul has been working here since March 1986, and I joined him in June. Paul was transferred here to become operations manager for Fairchild Semiconductor's Ceramic Assembly operation. I've been job hunting with no luck due to a recession and poor state of the shipbuilding industry. Thinking of starting a shipbuilding project planning consulting business. We are enjoying our stay but miss the change of seasons and the coast of Maine. If anybody is passing this way in their travels in the Far East, look us up!"

The Alumni Association has been very efficient lately, and I seem to get the slips of paper that you submit with your donations much faster now. Turnaround time from when you write the information until it appears in these pages is down to four or five months now. Of course, the fastest way is always to write me directly (three

to four months turnaround). Don't be discouraged; write soon!—**Sharon Lowenheim**, Secretary, 303 E. 83 St., Apt. 24F, New York, NY 10028

81

When this column appears, it will be almost summertime, a tremendous improvement over this cold and snowy New England winter.

Chuck Markham would like to know if anyone would like to purchase a class directory. They are certainly useful for contacting long-lost friends and make great gifts. They also seem to be cluttering Chuck's apartment. So, please place your orders now with checks payable to the Class of 1981 for \$8.10. Send requests to chuck at: 362 Commonwealth Ave., Apt. 2E, Boston.

Chuck was recently promoted to consultant at Bain and Co. in Boston. . . . **Rob Steinberg** writes to say that he is living in Washington, D.C., and loves his job! He was just promoted to manager. He reports that **Mike Gerardi** visited while in town for a law symposium. . . . A letter with foreign stamps comes from **Lew Bender**, who is working as a product manager for Micro Electronic Materials in Switzerland. Lew is enjoying the lifestyle and skis every weekend. He is learning french and yodeling. He invites classmates to write and visit. His address is: Rue Louis Bourguet #20, CH-2000, Neuchatel, Switzerland.

Elliott Berger is engaged to Stacey Hope Kent, a physical therapist from Lexington, Mass. They plan to marry in October 1987. . . . **Dave Slobodin** just finished his doctorate at Princeton. He will be working at Polaroid in Waltham, Mass. . . . **Joel Garcia** completed his naval service and received a "Gold Dolphin" for qualification in submarine warfare. He left Hawaii in November to work for Hamilton Standard Division of United Technologies in their Space and Sea Department as a special projects engineer.

Joseph Kesselman is still working for IBM (writing programs to aid in designing computers) in Kingston, N.Y. . . . **Steven Barwick** is a junior research specialist at the University of California, Berkeley. He is currently working on a balloon-borne experiment to measure low energy antiproton flux in cosmic rays. In late 1984, Steven married Laura Rodriguez, a Lesley College grad, in San Juan, Puerto Rico. . . . **Roger Ishimoto** is now working for E-Systems doing systems engineering and development for unmanned airborne vehicle electronic payloads.

William Uhle was transferred from Shaw AFB to Misawa AB in Japan, where he will still be flying the FIGC. Bill and Chandra had their second child, Robin Nicole, on November 18. . . . **Dave Kates** is working as a software development manager in IBM's Research Triangle Park in North Carolina on the recently announced Token Ring Local Area Network. He expects to graduate from Duke's executive M.B.A. program in August 1987. Dave has been running competitively in the Raleigh area at distances of 10K and up. . . .

Todd Sherman writes that he is working in product marketing at WYSE technology in San Jose. He says that all is well. **Lynn Radlauer Lubell**, 216 Beacon St., Boston, MA 02116

84

Hi gang! It's my turn again. Thanks for all of the news notes, please keep them coming! . . . **Robert Horwitz** writes that he is in his second year at Wharton. . . . **Pean Lim** is working for Teknowledge, Inc. in Palo Alto, Calif., and generally having a blast, only sometimes missing the good old Cambridge days. . . . **Ensign Heide Stefanyshyn-Piper** is busy fixing naval ships at Pearl Harbor Naval Shipyard, and enjoying sunny Hawaii. It's a tough job, but someone has to do it. . . . **Philip Kasten** has been working at AT&T Bell Labs in Andover, Mass., since graduation. He was recently engaged to his college sweetheart, Carolyn, and will be getting married in June 1987. He

would love to hear from any old friends (addresses can be obtained through the Alumni Association). . . . **Selina Lin** is a second year med student at University of Texas at Galveston. . . . **Jay Fridkis** is living in New York City. He finished his master's degree in international finance at Columbia University in December 1985, and currently works for AT&T in New Jersey.

Glenn Fleisig is working toward a master's degree in electrical engineering at Washington University in St. Louis. There was a big ski trip to Colorado in December, with **Glenn, Dave Abramsky, Mike Agronin, Howard Gordon, Mary Holly, Bobbie Hsi, Grant Johnson, Clara Chung, '85, John Repko, '82, and Arun Ram, '87, in attendance.**

Heni Meerman, our class agent, has moved from Texas to Georgia. He is currently assigned to the marketing department of a Goodyear SBR latex plant in Calhoun, Ga. He is keeping in shape by playing basketball every day at lunch, and also plays with the plant team. Heni plans to return to grad school in the fall for chemical engineering to concentrate in biotechnology. . . . **Kathy Takayama** writes that she attended the wedding of **Tomo Hasegawa and Shirley Young** in Massachusetts in September. The maid of honor was **Amy Chung** and the best man was **Carl Godkin**. In March Kathy will be moving to Rutgers Medical School but will officially remain a Stony Brook student. Her advisor will assume chairmanship of the Biochemistry Department, and the entire lab will follow.

Talar ni svenska? If you do, drop me a line! I'm looking for a pen pal so I can practice my Swedish. Let's hear from more of you! We need new news to print!—**Diane M. Peterson**, President, 350 Palos Verdes Blvd., Apt. 20, Redondo Beach, CA 90277-6329, (213) 375-4991

86

Hey dudes, what's happening? I've received lots of info on the class this month—keep up the good work. I also received an address list from the Alumni Association, so if you're interested in finding someone's whereabouts, send me a self-addressed stamped envelope and I'll be happy to oblige.

Those regional parties are still on schedule for June 27. The LA area get-together will be held at my apartment—415 Herondo St., No. 184, Hermosa Beach, Calif., (213) 372-3761. For information on other regions, contact **Vivienne Lee**, (513) 471-8930. Hope to see everyone there.

Mary Ystueta wrote me a novelette concerning her travels over the past several months. She is currently at Georgia Tech working on a Ph.D. in electrical engineering. During winter break, she drove up to Long Island, N.Y., making a few stops along the way. In Burke, Va., Mary saw **Beth Dernbach** who's working for American Systems Corp. in Annandale, Va. **Sherri Hess** is also in the northern Virginia area, and together they did the D.C. scene; unfortunately, they didn't make it to the Hangar Club. Some hearsay picked up here places **Greg Berthiaume** at Penn State getting his Ph.D. in physics.

Mary's next stop was the Princeton Graduate School of Chemistry where we find **Yong Mi Choi** working diligently. **Yong Mi** had some info which she passed on. . . . **Andrew Joe** is in Boston working for the Arthur D. Little Corp. . . . **Eric Ginsburg** is at Caltech playing frisbee and working for a Ph.D. in Chemistry. . . . **Rich Roth** is in New York applying to grad schools in material sciences. . . . **Ellen Dixon** and **Keith Law** tied the knot last summer in North Carolina. The Laws are currently in Boston, where Ellen is attending Harvard Law School.

On to historic Philadelphia to visit **Sharon Israel** and **Cheryl Ingram**. Sharon is working for GE, and Cheryl is at University of Pennsylvania working for her Ph.D. in molecular biology. . . . **Daniel Kulp** and **Gabrielle Hecht** are also at University of Pennsylvania in Ph.D. programs. . . .

Michelle Lin is in Philly, too, at Penn Medical School. . . . A small reunion was held and **Beth, John Villani, Marta Diaz, John Swartz** and **Rose Joseph** were in attendance. Rose is working for IBM in Kingston, N.Y., designing power systems, and John Swartz is with RCA in Burlington, Mass. Sharon and Rose managed to get free orchestra seat tickets to the second half of *Cats* in New York City—they'd like to know if anyone has tickets to the first half? . . . **Toi Beveridge** is living it up at Carnegie Mellon where she's pursuing a master's in industrial administration. . . . **Scott Morrison** and **Stewart Clamen** (his roommate) are also in the same program there. . . . **Hannah Bond** is working for Corning in Corning, N.Y., where it seems she's about the youngest person in the town. . . . **Alka Jain** will receive an M.B.A. from Columbia in June and is really enjoying New York City. **Reese Corlandi** is in Huntsville, Ala., and **Pat Leach** is working as a chemical technician in Massachusetts.

Mary's letter continues. **Kim Hunter** is presently running her own shop in Hanover, N.H. John Villani and **Roger Biasca** graduated in December; John will work in the Boston area and Roger will either go on to Stanford, Cornell, or M.I.T. for further study. . . . **Lisa Mitchell** is finishing her coop in electrical engineering and currently lives in Green Hall. . . . **Martha McKinney** is working for Beth Israel Hospital in Boston, and **Sarah Danca** is with the Danca Corp., also in Massachusetts. Sarah relates that **Dennis Cuy** is adjusting to life in Utah working for TRW and is currently involved with helping high school students learn more about career opportunities as a Junior Achievement Advisor. Thanks for all the data, Mary.

Ron Bloom dropped me a line to say that he and **Dave Stampleman** are working for Boeing in Seattle. Ron is in the hydraulics and landing gear group for the 747, and Dave is in the loads and dynamics group for the 737.

Bernie Teh wrote in that he is presently at Stanford Business School in the M.B.A. program. He's having a fantastic time but misses IAP—his Christmas vacation was only two weeks long. Other Stanford classmates include **Panos Babalitis** mechanical engineering, **Dara Foias** computer science, **Mitch Oslick** electrical engineering, **Sanjay Govindjee** mechanical engineering, **Alex Wang** computer science, **Joon Ooi** civil engineering, **Dihn Le** medical school, **Al Yen** aerospace engineering, and **Vida Simonaitis** materials science. Bernie also has found that several classmates are working in the Bay area. . . . **Gordan Shaw** is with SENTRY Semiconductors and **Kenneth Chen's** at Ford Aerospace. . . . **Shankar Raman** is working for his Ph.D. in electrical engineering at Berkeley; Bernie ran into him at Thanksgiving. . . . Shankar informs us that **Jehanbux Edulbehram** is having an excellent time at UC, San Diego. I was in San Diego over New Year's, and I concur with Jehanbux wholeheartedly.

Classmates that remain in Boston include **Christine Chan** (at DEC), **Beng Lin** and **Mandy Ng** (at Palladian Software), **Leon Rosenberg** (Bain & Co.), **Tong Lee**, **Karen Covert** and **John Lin** (M.B.A.'s at Sloan), and **Ricardo Jenez** (in a computer science lab at M.I.T.). Bernie concludes his letter saying that **Janet Hirata** is with Morgan Stanley in New York. He extends an invitation for a tour of Stanford to any classmate who may be in the area.

James Berrettini, a.k.a. Penn Jacobs, worked for a short spell as a technical consultant at Fish & Richardson, a Boston law firm specializing in patents. He is now employed by Digital in Hudson, Mass., and in his free time has begun recording an album in New York City. His group is Penn Jacobs' Metro-Baptists and the album, on the Jammin' Jah label, is tentatively titled "Life-style Accessories." . . . **Jennifer Solomon** is enjoying Texas where she works in the Dallas office of Booz-Allen and Hamilton. She also spends a great deal of time in San Francisco. . . . **Stephen Andes** is employed by GE in Wilmington, Mass., helping to manufacture aircraft instruments. . . .

Banleng James Toh is a recruit in the Singapore Armed Forces undergoing basic military training and making a huge \$64 a month. He'll be in the army for two-and-one-quarter years; this is part of the mandatory military service required in Singapore. . . . **Beatriz Garcia** spent last summer touring Europe and the Middle East and is finally settling into her job at Hughes Aircraft in El Segundo, Calif. (right down the street from me).

I'll be running a 10K in Playa Del Rey, Calif., on Valentine's Day with **Greg Harrison**. He had some news which he passed on to me. **Paul Hermann, Ben Costello** and **Chuck Lauhon** are at Berkeley for graduate school in chemistry, biomedical and chemistry, respectively. They share an apartment in Oakland. . . . **Katy Kelly** is surviving the rigors of BU Medical School and has not set nachos on fire for several months. . . . **Ray Covert** is working for LTV in Dallas but is thinking about joining Paul, Ben, and Chuck at Berkeley. . . . **Fred Huetting** has returned to M.I.T. for his master's in electrical engineering. . . . **John Rulnick** has decided to fulfill his ambition of becoming a sports broadcaster. The NBA, NHL, and NFL are all anxiously awaiting his graduation from broadcasting school. . . . **Pete McEwen** is working for Digital and still finds time for tanning and weightlifting, and **Brett Pichon** is still at Chanute AFB, Ill. I think **Lizet Tirres** is there also. They should be finishing up and ready to move on to permanent assignments.

Sonya Sakai, along with Greg, just returned from a two-week course in systems acquisition at San Antonio, Tex. She had gathered quite a bit of gossip. **James Person** is living in Chula Vista, Calif., with **Jim Butler** and **Greg Stewart**. He and **Chris Medina** are assigned to the same destroyer in the navy. . . . **Kathy Kim** is working for Proctor and Gamble in Fairfield, Ohio. . . . **Jim "Buck" Someren** is attending Emory Medical School in Atlanta, Ga., and **Tony Pu** and **Brian Strauss** are at Washington University Medical School in St. Louis. . . . **Dennis Arnow** and **Brian Mulcahy** are employed by Booz-Allen and Hamilton in Bethesda, Md. . . . **Young-Jo Kim** is at Harvard Medical School. . . . **Mary Manger** and **Sergio Ajuria** have Bell Lab's Ph.D. scholarships, and **Tom Chang** and **Mark Wolfe** are still at M.I.T. working on their five-year 3-B masters. . . . **John Barbour** is stationed at Randolph AFB, Tex. He went on the TV game show *Scrabble* and won \$17,000. Must be nice! . . . **Steve Baraniak** and **Alain Cohen** are working on their own in Washington, D.C. . . . **Lisa Bell** and **Amy Lee** are working on their master's at the University of Texas. . . . **Vic Christensen** is waiting to enter the air force in November; meanwhile, he's working in San Pedro, Calif. . . . **Dave Martin** is employed by Oracle in San Jose, Calif., when he's not scooting around the San Francisco Bay in his boat. . . . **Robert Lenoil** is also in San Jose, working for Apple. . . . **Mark Lucente** is back at M.I.T., pursuing his master's degree. The following 6-A's have one more term to go—actually, by the time this is printed, they'll probably already have graduated: **Greg Greeley**, **Bill Mayweather**, **Greg Zehner**, and **Tom Crowley**.

Greg Harrison gave a party a couple of weeks ago. . . . **Jim Wilkerson** was here in California doing testing with the Daedalus group out at Vandenberg AFB. He's working in Massachusetts until he goes active duty and heads off to pilot training. He told me **Diane Quick** and **Marilyn Oberhardt** are sharing an apartment in Boston; Diane's working on her master's at M.I.T., and Marilyn is at Hanscom AFB at the Geophysics lab. . . . **Pam Sullivan** is in Colorado until she heads down to Johnson Space Center in Houston, Tex.

Finally, I attended a class at Ford Aerospace in Sunnyvale, and my instructor happened to be a fellow Aero/Astro—Victor Agüero, '84. Michelle Devereux, '83, was also in the class. Alumni, it seems, are everywhere. Keep up those letters—we'll have the biggest column yet.—**Mary E. Cox**, Secretary, SD/CLTPC LA AFS, P.O. Box 92960, Los Angeles, CA 90009-2960

I CIVIL ENGINEERING

Robert F. Lathlaen, S.M.'46, of Hastings-on-Hudson, N.Y., president of W.J. Barney Corp., New York, builders and construction managers and developers, reports that he is a director of the American Arbitration Association, a trustee of St. Vincent's Hospital and Medical Center, and lecturer in construction management at New York University. . . . **Dario Valencia-Restrepo**, C.E.'72, who teaches mining engineering at the University of Antioquia, Medellin, Colombia, was visiting scholar at the Parsons Laboratory, M.I.T., last October and November. . . . **Kenneth L. Recker**, S.M.'73, has been promoted to associate and vice-president of Haley and Aldrich, Inc., geotechnical engineers, geologists and hydrogeologists; he is assistant branch manager in the firm's Portland, Maine, office. . . . **John B. Scalzi**, Sc.D.'51, is director of the National Science Foundation's research granting program concerned with the preservation of the country's public works and infrastructure.

Thomas Asselin, S.M.'66, is senior partner in the Atlanta, Ga., law firm of Peterson, Young, Self, and Asselin, which specializes in representing contractors, architects, engineers, and owners in construction disputes nationwide. . . . **Thomas S. Maddock**, S.M.'51, who works with Boyle Engineering Corp., Newport Beach, Calif., was honored twice last year: he received the Moreel Medal of the Society of American Military Engineers and the Outstanding Engineer Merit Award (civil engineering) of the Los Angeles Institute for the Advancement of Engineering. Maddock is serving as 1986-87 president of the Los Angeles Section of the American Society of Civil Engineers. . . . **Kenneth R. Maser**, Ph.D.'71, is a research associate in the department at M.I.T., where he is studying the application of sensor technology to infrastructure management. Maser's research projects involve leak detection in pipelines and storage tanks, inspection for bridge deck deterioration, and analysis of pavement condition. His new course, "Automated Sensing of In-Site Conditions," is helping to prepare students for research and practice in the newly emerging field.

Richard R. Pikul, S.M.'67, writes that he has been operating his own consulting practice for the last six months. Last January he became principal in the engineering firm of Ryan-Biggs Associates, PC, Troy, N.Y. . . . **Fred W. Blaisdell**, S.M.'34, retired last July from the Agricultural Research Service, United States Department of Agriculture, after 50 years of service. . . . **Joseph A. Racosky**, S.M.'75, reports, "My Christmas gift for 1985 was a layoff notice from my employer, the Denver Regional Transportation District, where I was assistant manager, information systems. So I started my own consulting practice in civil/transportation engineering and computer systems planning. I've survived my first year and now enjoy a healthy backlog of projects. Having a lot of fun!"

John Lowe III, S.M.'37, writes, "Retired as

partner of TAMS, New York, engineers, architects and planners, on December 31, 1983. Since then have been working part-time as a consulting civil engineer on dam projects in Pakistan, Lesotho, and Ohio. Gave the Martin S. Kapp Memorial Lecture on April 9, 1986, on the topic of roller-compacted concrete. I pioneered the first use of this technology in Shihmen Dam, Taiwan, in 1962." . . . **Gershon Kulin**, Sc.D.'55, recently retired from the National Bureau of Standards, Washington, D.C. . . . **Dennis E. Kuzak**, S.M.'70, has a new job: formerly director of corporate treasury services for Kaiser Aluminum and Chemical Corp., he is now director of asset and liability management at World Savings and Loan, Oakland, Calif. . . . A graduate of Carnegie Mellon (Ph.D. 1986) and the Indian Institute of Technology, Madras, **Duvvuru Sriram** joined the department at M.I.T. last fall as assistant professor. He is a specialist in the application of artificial intelligence to engineering and design, and he was technical chairman of the first International Conference on the Applications of AI to Engineering Problems held in England last summer.

A \$50,000 assessment of eastern U.S. seismicity by Professor **Daniele Veneziano** of M.I.T. is included in the first-year research plan of the controversial National Center of Earthquake Engineering Research at the State University of New York at Buffalo.

II MECHANICAL ENGINEERING

To **Ali S. Argon**, Sc.D.'56, Quentin Berg Professor at M.I.T., the grade of fellow in the American Physical Society "for experimental research on material properties at extremely high dynamic temperatures and pressures, and for . . . establishing an accurate pressure scale . . . above one megabar." . . . **John R. Manning**, Sc.D.'67, group leader for metallurgical processing, Metallurgy Division, National Bureau of Standards, has been made a fellow of the American Society for Metals. . . . **William Coleman**, S.M.'46, general manager of corporate research and development at the Eaton Corp., Detroit, has been elected the 1987 president of the 49,000-member Society of Automotive Engineers. Coleman worked at General Motors Research Laboratories, Minneapolis-Moline, and American Motors before joining Eaton. . . . **Tseng Y. Chow**, S.M.'48, retired last June as professor of mathematics from California State University, Sacramento. . . . **Yannick Belliato**, S.M.'81, writes, "Have spent four years in an engineering company making rolling mills and finishing lines for ferrous and non-ferrous metals as a contract sales engineer; joined (in 1985) Roquette Freres, France, a starch and starch derivatives maker, as a technical/commercial engineer; and am now in Tokyo to promote sales of Roquette's products from a technical point of view."

Charles R. Faulders, Sc.D.'54, writes from Rockwell International, Canoga Park, Calif., "Overseeing a geothermal project for the United

States Department of Energy, which has guaranteed a several-million-dollar loan for the project. Should complete construction in July. . . ."

Thomas A. Blatt, S.M.'59, of Weston, Mass., is president of Intrax Corp., which he describes as "a small international firm engaged in business development activities, primarily international trade development for American companies with technical products." . . . **Don F. Pardo**, S.M.'80, recently formed Digital Sciences Corp., San Diego, a software engineering firm specializing in business and scientific applications on Digital Equipment VAX computer systems. Major clients include the United States Navy and Martin Marietta.

Jack B. Chaddock, Sc.D.'55, finally took a sabbatical leave from Duke University after 20 years as chairman of the Department of Mechanical Engineering and Materials Science. For the past year (July 1986-July 1987) Chaddock has been a visiting research associate in the Department of Mechanical Engineering at the University of California, Berkeley, and at the Applied Science Division, Lawrence Berkeley Laboratory. . . . **Francis J. Zimmermann**, Sc.D.'53, retired in June 1986 from the Department of Mechanical Engineering at Lafayette College, Easton, Penn. . . . **William B. Hoff**, S.M.'80, was promoted to manager of the Robotic Systems Division of Rockford Automation, Rockford, Ill. . . . **Mark A. Kniffin**, S.M.'81, of West Roxbury, Mass., writes that he is involved in "research and development of high-speed computer cooling and interconnect."

Michael J. Bear, S.M.'84, is attending the Harvard Business School, working on his M.B.A. . . . **John Wlassich**, S.M.'86, reports, "Upon graduation from M.I.T., I embarked on a four-month trip to India, Nepal, Thailand, Mainland China, Japan, Australia, and Fiji. Last October I advanced to BDM Corp., Panama City, Fla., as an associate engineer."

Honored for his research in characterizing multicomponent flow fields, **Harri Kytomaa**, assistant professor at M.I.T., has been appointed to an Atlantic Richfield (ARCO) Career Development Professorship in Energy Studies. Kytomaa came to M.I.T. in 1985 after studies at Durham University, England, and Caltech; he has a strong background in fluid mechanics, thermodynamics, and heat transfer.

Rohan Abeyaratne came to M.I.T. as associate professor of mechanical engineering from Michigan State last fall; he holds degrees from Caltech and the University of Ceylon, and his major research is in stress-induced phase transformations and fracture mechanics in metals. Two assistant professors also joined the department last fall: **Emanuel M. Sachs**, Ph.D.'83, whose current research is on the manufacture of silicon substrates for solar cells; and **Harry West**, Ph.D.'86, a graduate of the M.I.T. Technology and Policy Program who is now working on robotics and computers to link design and manufacturing.

III MATERIALS SCIENCE AND ENGINEERING

To **Margaret L. A. MacVicar**, Sc.D.'67, Cecil and Ida Green Professor of Education and dean for undergraduate education at M.I.T., the grade of fellow in the American Physical Society "for research on transition-metal superconductivity and for innovation in education."

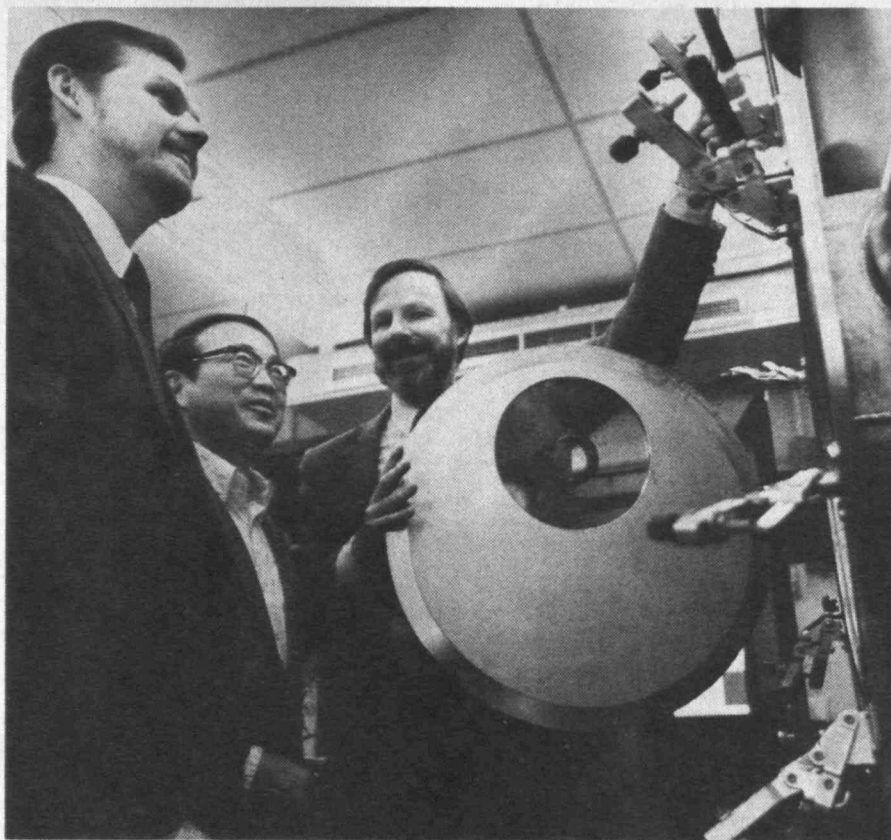
Three alumni in the department were honored as fellows of the American Society for Metals last October: **David J. Duquette**, Ph.D.'68, professor of metallurgical engineering in the Materials Engineering Department at Rensselaer Polytechnic Institute, Troy, N.Y.; **Joseph I. Goldstein**, Sc.D.'64, vice-president for research and professor in the Department of Materials Science and Engineering at Lehigh University, Bethlehem, Penn.; and **John F. Wallace**, S.M.'53, Republic Steel Professor of Metallurgy and Material Science at Case Western Reserve University, Cleveland. . . . **Stanley Weiss**, Sc.D.'65, has retired to the post of professor emeritus in materials engineering in the College of Engineering and Applied Science, University of Wisconsin, Milwaukee; he is now president of Weiss and Burck, Ltd., consulting engineering, Milwaukee. . . . **Ernst B. Weglein**, Met.E.'59, is with the law firm of Testa, Hurwitz, and Thilbeault, Boston.

Nun-Sian Tsai, Ph.D.'83, writes, "After graduation, I joined Bell Laboratories, Reading, Penn., working on high-voltage silicon device fabrication for telephone switching systems. In 1986, I transferred to Bell Labs in Allentown, Penn., to work on new material development for VLSI." . . . **William H. Rhodes**, Sc.D.'65, on the staff of GTE, Waltham, Mass., has been named president-elect of the American Ceramic Society.

Joan Adams, S.M.'80, of Washington, D.C., writes, "Head up U.S. division of French subsidiary of EdF (Electricite de France). Help small hi-tech French companies enter the U.S. market and license U.S. technology for manufacture in France. Represent EdF energy technology for the construction of turnkey hydro, cogeneration, and trash-to-energy projects." . . . From **Thomas R. Clevenger**, Sc.D.'61: "Another successful year in Tokyo, as TRC Associates, my consulting business, continues to thrive. Son Douglas is now a junior in Course XV."

James A. Cornie, principal research associate in the department at M.I.T., now heads a new Center for the Processing and Evaluation of Metal and Ceramic Matrix Composites, and a research consortium is being formed to support its work. With a goal of understanding the relationships between processing, microstructure, and materials processes, the center will work chiefly to improve the properties of aluminum and magnesium alloy matrices and ceramics matrix composites.

The 1987 New England Award of the Engineering Societies of New England has come to **Morris Cohen**, Sc.D.'36, Institute Professor Emeritus at M.I.T., to recognize his status as "the preeminent academic leader in the field of materials science and engineering. . . . Through the force of his in-



The newest showplace of the Department of Materials Science and Engineering is this Central Facility for Rapid Solidification Processing. Its equipment allows for rapid cooling of molten metals and alloys—usually on the order of one million degrees per

second. In the photograph are (left to right) Professor Gregory J. Yurek, faculty supervisor; Wu-Xian Wang, facility manager; and Professor J. David Litster, Ph.D.'65, director of the Center for Materials Science and Engineering through which NSF funds the facility.

tellekt and his tireless activities, he has—more than any other living person—defined the field as we know it today and shaped the character of its institutions."

Three new members of the faculty are completing their first year of teaching at M.I.T. this spring: **Michael Cima**, **Andreas Mortensen**, Ph.D.'86, and **Michael F. Rubner**, Ph.D.'86. Cima, who had been with the Lawrence Berkeley Laboratory, is working on the chemistry of ceramics processing and powder synthesis; Mortensen teaches physical metallurgy and is doing research on metal matrix composites; and Rubner is continuing work on polymers with novel electrical, optical, and magnetic properties.

The department's new undergraduate laboratory in Room 13-4027 was completed late last year and designated the L.G. Balfour Laboratory to recognize the contribution of \$1 million from the L.G. Balfour Foundation. Renovation of other teaching facilities continues under the Balfour grant.

John H. Dedrick, Jr., Sc.D.'48, of Richmond, Va., formerly of Milwaukee, Wis., passed away on December 20, 1986. Until his retirement in 1981, Dedrick served as general director of the Metallurgical and Chemical Research Division of Reynolds Metals Co., and after retirement he continued as a consultant to the division. . . . **Nils Christensen**, Sc.D.'52, of Trondheim, Norway, passed away on November 9, 1985; no further details are available.

IV ARCHITECTURE

Rod Leung, M.A.A.'78, of Marietta, Ga., has been promoted from project manager to associate member of Cooper Carry and Associates, Inc., Atlanta. Leung joined the firm in 1984 and has been a project manager for the 4-million-square-foot mixed-use complex of Prudential Buckhead, Atlanta, and the twin towers Dunwoody Springs Office Park. . . . **Susan Myers**, M.Arch.'77, has opened her own architecture office in Cambridge. . . . **G. Norman Hoover**, M.Arch.'64, is director of architecture and planning for 3D/International, Houston. He joined the firm in 1983 as senior vice-president and a member of the Board of Directors. He was elected (1981) a fellow of the American Institute of Architects.

Robert S. Allan, M.Arch.'55, writes from his office at Robert S. Allan and Associates, "We are building some very interesting projects. Former classmates and friends are welcome visitors. My office phone is (214)257-3152 and we are located at 420 Decker Drive, Irving, Texas, near Dallas Cowboy Stadium." . . . **Eugene Magenau**, '34, reports from Potter Place, N.H., "Although I retired back in 1973, I have been working as consultant for an architect-engineer firm in New London, N.H., four days a week for the last couple of years. I pass along issues of *Technology Review* to my nephew after reading them cover to cover." . . . **Ewart A. Wetherill**, M.Arch.'58, moved to a

new firm, Wilson Ihrig and Associates, Oakland, Calif., in late 1985.

Chu-Tzu Hsu, M.A.A.'76, writes, "In 1984, I started my own architectural firm, C.T. Hsu and Associates, Orlando, Fla. We have recently won a design award for the Ran-Getso of Tokyo restaurant project in Orlando." . . . **George William Smith**, M.Arch.'54, writes, "Two members of the class of 1954 and their architectural firms are collaborating on the design and construction coordination for American Stores Co. of several mercantile markets in the three-state Delaware Valley area. Construction drawings for new and renovated food markets in Pennsylvania, New Jersey, and Delaware are prepared by FFKR, Salt Lake City, the firm of **Robert A. Fowler**, M.Arch.'54, and the projects are administered by Johnson/Smith, the firm of **George William Smith**, M.Arch.'54, in Philadelphia."

Tom Machover, assistant professor of media technology in the department at M.I.T., is the first director of the new Philippe Villiers Experimental Media Facility in the Wiesner Building. The EMF is a 200,000-cubic-foot space (four stories tall, about 60 feet square) designed for research and performances—"a bit like a sound stage on a movie lot because you can create just the reality you want," says Machover. It's a facility of the Media Laboratory directed by Professor **Nicholas Negroponte**, '66, made possible by gifts of **Philippe Villiers**, '60. Machover came to M.I.T. in 1985 after six years as director of musical research at the Institut de Recherche et Coordination Acoustique/Musique, Paris, one of the world's leading centers of computer music; he is known for innovative composition and research in computer music.

Assistant Professors **Edith K. Ackermann** and **William Q. Hubbard** are completing their first year of teaching at M.I.T. this spring, having joined the department last fall. Ackermann, associated with the Media Laboratory, is working on model building as an expression of children's ways of thinking; Hubbard is studying new patterns of urbanism while experimenting with architectural composition as a basis for teaching design.

Paul Peng-Cheng Sun, M.Arch.'66, of Shepley Bulfinch Richardson and Abbott, Arlington, Mass., a resident of Watertown, Mass., passed away on December 8, 1986; no further details are available.

V CHEMISTRY

To **Horia Metiu**, Ph.D.'74, of the University of California, Santa Barbara, the grade of fellow in the American Physical Society "for insightful contributions to understanding surfaces and adsorbates using spectroscopic techniques." . . . **John A. Rollino**, Ph.D.'69, professor of chemistry and physics at Upsala College, East Orange, N.J., reports that last summer he attended the Woodrow Wilson National Foundation Fellowship Summer Conference on Global Interdependence at Princeton University. . . . **James J. Bishop**, Ph.D.'69, of Philadelphia, reports that on October 11, 1986 he married Dr. Rudine Sims, professor of education at the Ohio State University. . . . **Charles V. Berny**, '54, reports that he "organized the W.S. Gilbert Sesquicentennial Symposium held at M.I.T. last November. The event commemorated the 150th birthday of the Victorian playwright and was attended by about 100 Gilbert enthusiasts from England, Canada, and the United States."

Ernest Lustig, Ph.D.'57, reports that he retired last September 30 after 14 years in the rank of full professor and chief of the Division of Instrumental Analysis at the Society for Biotechnological Research, Braunschweig, Germany. . . . **John T. Viola**, Ph.D.'67, reports, "At Rockwell's Science Center, I am program manager for space programs—working with NASA's 'Centers for the Commercial Development of Space.' I am also responsible for infrared detector development for

defense and commercial applications. Enjoying southern California sunshine." . . . **R.A. Gottscho**, Ph.D.'79, of Maplewood, N.J., received the American Vacuum Society Peter Mark Memorial Award. . . . **Homer Fay**, Ph.D.'53, reports, "Now retired from Union Carbide Corp. and doing consulting and operating a small business, Falite Instruments. Marion and I enjoy sailing our yawl *Glissando* on the Great Lakes. I also play trombone in two brass groups. Last Christmas we went to Seattle to visit our son Frank (M.I.T. Class of '79-XIII)." . . . **Steven J. Gould**, Ph.D.'70, has been promoted to professor of chemistry at Oregon State University, Corvallis.

VI ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Charles A. Zraket, S.M.'53, president of MITRE Corp., is co-editor of *Managing Nuclear Operations*, a collection of studies by 22 experts co-sponsored by the Brookings Institution and the Harvard Center for Science and International Affairs. The thesis is that the danger of nuclear war is not only at its beginning but at its ending: the mechanisms that have so far prevented the outbreak of nuclear war must be supplemented by systems to overcome the inevitable chaos of war so that hostilities could be ended.

John A. Tucker, director of the VI-A program, reported late-winter visits from **Scott E. Cutler**, Ph.D.'76, of Arlington, Texas, who was on campus recruiting for his employer, Tandy Corp., and **John William Poduska**, Sc.D.'62, founding chairman and president CEO of Stellar Computer, Inc., Newton, Mass., who is widely known as founder of Apollo Computer.

What future for "electronic publishing"? asks **Peter J. Denning**, Ph.D.'68, director of the Research Institute for Advanced Computer Science at the NASA Ames Research Center, in the November-December issue of *American Scientist*. By "slowly but steadily transforming every aspect of publishing," he writes, the computer presents scientists with "a golden opportunity to share their ideas with more of their colleagues." But the other side of the coin is that electronic publishing "threatens them with an ever-increasing flow of mediocre publications." Denning complains of these aesthetic problems: typefaces that "are irritating and even difficult to read," layouts based on authors' personal whims instead of established standards of style and taste; and the breakdown of conventions of quality—the presumption that quality of printing correlates with quality of thought. Finally, Denning suggests that electronic publishing is responsible for "a growing tension between technical authors and editors," the editors accusing authors of thinking that "technology automatically makes them good writers."

Two alumni of the department were honored with the grade of fellow in the American Physical Society early this year.

□ **Silas J. Allen, Jr.**, Ph.D.'65, of AT&T Bell Laboratories, Murray Hill, N.J., "for creative far-infrared spectroscopy" . . .

□ **Peter J. Catto**, S.M.'67, senior staff scientist at Science Applications, Inc., Boulder, Colo., "for contributions to plasma theory . . . and to the theory of particle gyrokinetics."

A new *International Journal of Supercomputer Applications* founded by the M.I.T. Press will benefit from the membership of **Arvind**, associate professor of computer science and engineering at M.I.T., on its Advisory Board.

Dean H. Vanderbilt, Ph.D.'70, writes from Dallas, "I have joined Recognition Equipment, Inc., as vice-president of financial services. I am also serving (for a third two-year term) on the Dallas City Council." . . . **Miles Posen**, S.M.'84, is a manager for production mechanization and automation at Beltone Electronics Corp., Chicago. . . . **Arthur I. Hersh**, E.E.'70, has been named vice-president and general manager of the Communications Systems Division of GTE Government Systems Corp., Needham, Mass. Formerly Hersh

served as vice-president and general manager of GTE's WIS Division, Billerica, Mass.; he's been with GTE since 1957.

Donald D. Holmes, S.M.'50, retired as director of new television technology research at RCA Laboratories David Sarnoff Research Center, Princeton, N.J., after 36 years of service. In that time, Holmes was issued 30 U.S. patents and hundreds of foreign patents in electronic circuits and TV systems. . . . **Roy G. Saltman**, S.M.'55, reports, "I have received a three-year grant from the John and Mary Markle Foundation (through my employer, the National Bureau of Standards) to continue and extend previous work on the use of computers in vote-tallying." . . . **Eric S. Beckjord**, S.M.'56, was appointed director of the Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, D.C., after two years as a visiting professor in the Department of Nuclear Engineering at M.I.T.

From **Marko Slusarczyk**, Sc.D.'79: "It has been a year since I went out on my own as a consultant. I have survived the first year with no problems. In fact, I recommend it to anyone willing to take a chance." . . . **Michael Strieby**, Sc.D.'55, of Chatsworth, Calif., writes, "I am now retired from Hughes Aircraft and teaching electrical engineering at California State University. Also traveling and involved in investing, which I also track, and a bit of local politics." . . . **Sidney Topol**, '50, is chairman and chief executive officer of Scientific Atlanta, a new Fortune 500 company. . . .

Richard Tsien, S.M.'66, professor of physiology at Yale University, received a Javits Neuroscience Investigator Award last December for his research on disorders such as epilepsy and defects in neurotransmitter release. Tsien's new research will focus on the role of calcium channels in neuronal function. . . . **Douglas P. Looze**, Ph.D.'78, has been named associate professor of electrical and computer engineering at the University of Massachusetts, Amherst. Looze was formerly a senior scientist at Alphatech, Inc., Burlington, Mass.

Rudolph E. Kalman, S.M.'54, graduate research professor and director of the Center for Mathematical System Theory at the University of Florida, received the 1986 Steele Prize for a Fundamental Paper from the American Mathematical Society. Kalman's work, reported in three papers published between 1960 and 1963, is described as "a cornerstone of the modern theory and practice of systems and control." In his response to the award, Kalman writes, "There is a new symbiosis between mathematics and reality. The new magic is that mathematics helps to conceive machines and systems before they can be actually built."

William J. Dally joined the department at M.I.T. as assistant professor last fall after completing his Ph.D. at Caltech; his fields of interest include computer architecture, programming systems, and VLSI processors.

The Society of Mind (Simon and Schuster, 1987) by M.I.T. Professor **Marvin Minsky** is attracting widespread attention. In a promotional "blurb," Edward O. Wilson, Baird Professor of Sciences at Harvard, describes the book as "a unique and provocative advance in human thinking." Minsky's basic concept is that "you can build a mind from many little parts, each mindless by itself." But joining these little parts ("agents," he calls them) into societies "can lead to true intelligence."

William C. MacInnes, S.M.'27, a Tampa civic leader who was chairman of the executive committee of TECO Energy, Inc., and former president of the Tampa (Fla.) Electric Co., passed away on December 16, 1986. When MacInnes assumed leadership of Tampa Electric it had 700 employees and annual revenues of less than \$17 million; today it employs 3,500 and generates revenues of \$860 million. As president of the Greater Tampa Chamber of Commerce in 1975 MacInnes helped to develop the Tampa Industrial Park, and nine years later he was named Cultural Contributor of the Year by the organization. In 1968 MacInnes was named by President Lyndon Johnson to head the Alliance of Businessmen, a task force

on the hard-core unemployed. . . . **Walter H. Esdorn**, S.M.'34, of Boca Raton, Fla., passed away October 6, 1986; no further details are available.

VI-A Internship Program

VI-A entered its 70th year with the annual meeting and dinner followed by a company open house in the Student Center on March 2. Just over 100 enjoyed dinner in the Mezzanine Lounge and heard Robert K. Weatherall, director of M.I.T.'s Career Services Office, comment on this year's placement outlook.

There were 172 applications for this year's VI-A class, whose size has been set at about 90. In two days the VI-A companies held a total of 958 interviews with these applicants. Final selection of the new class will be completed by mid-April.

The Naval Surface Weapons Center (NSWC) has rejoined the selection process after a three-year period of no new students. **Daniel J. Jablonski**, S.M.'77, who was our technical co-ordinator there, has left to join DARPA.

The purchase of RCA by General Electric Co. and consequent consolidation has put the Sarnoff Laboratories on hold this year, but its present students are continuing their assignments.

It is with sorrow that I report the death of one of our past VI-A directors, Professor **Eugene W. Boehne**, S.M.'28. Gene was director of Course VI-A from 1947 to 1960. He died in the M.I.T. Infirmary on February 22, 1987, after a long illness. I had visited him several times and most recently two days before his passing. I can recall my first connection with VI-A just after I joined M.I.T. in 1956: Gene and his wife would have groups of VI-A students to their home in Wellesley, and I was invited. Annually he held a late summer camping weekend in the Berkshire Hills near Pittsfield, Mass., for VI-A's. I recall, too, assisting him with a television program on WGBH called "Brain Teasers" that he hosted once a week. In 1936 Gene was awarded an honorable mention by the Eta Kappa Nu honorary as an "Outstanding Young Electrical Engineer." Gene was a deacon of the Wellesley Hills Congregational Church, where I now serve, and his son was a member of the Scout troop there.

Another death, brought to my attention, is that of **Herbert N. Nock**, '21, who was 87 when he passed away on January 23, 1987 in Newburyport, Mass. He was employed by the General Electric Co. in Lynn, Mass. for 20 years.

A signal honor—Presidential Young Investigator Awards from the NSF—has come to two VI-A alumni: **Denise D. Denton**, E.E.'83, who has just completed her Ph.D. requirements at M.I.T. and is joining the faculty of the University of Wisconsin at Madison this spring; and **Dennis L. Polla**, E.E.'81, who this past fall joined the Yale faculty under an IBM Faculty Development Award. Polla received Ph.D. and M.B.A. degrees from the University of California, Berkeley, in 1986, where he also received three teaching awards. His research interests are in silicon integrated sensors and mercury cadmium telluride device physics. To my knowledge they are the first VI-A graduates to receive this award. Before she left for Wisconsin I was able to personally offer Denise our congratulations.

A new school, Gordon Institute, will hold its first classes on May 11, 1987; announcement was made by **Bernard M. Gordon**, S.M.'40, founder of Analogic Corp. The Institute will offer a degree of master of science in engineering management; engineering excellence and leadership qualities are its main goals.

A current VI-A student, **Stephen J. Ponzio**, '88, was named a 1987 Burchard Scholar in the School of Humanities and Social Science at M.I.T. The 17 juniors and three sophomores who were selected in this second year of the Burchard Awards gather for interdisciplinary discussions with M.I.T. faculty and visiting scholars.

A number of VI-A's have been on campus representing their companies in connection with recruiting. A very pleasant reunion and luncheon

was had with **Geoffrey J. Bunza**, Ph.D.'81. Geoff is with Mentor Graphics, Inc., of Beaverton, Ore., as director of engineering; **Stephen Swerling**, '63, was a founder and is now vice-president—engineering.

Others whom I met in the Career Services Office included: **Thomas A. Fitzpatrick**, S.M.'86, for Digital Equipment Corp; **Stephen J. Hazlerig**, S.M.'81, for Microsoft; **Kevin D. Stoddart**, E.E.'73, for Watkins-Johnson; and **Jeffrey Yorsz**, E.E.'83, for Adaptive Optics Associates, Inc.; and I had a pleasant office visit from **Lynn M. Roylance**, '72, of Hewlett Packard Laboratories.

As best I can determine (and I apologize if I missed some), the following VI-A graduates attended one day or all of the annual selection activities: **Steven L. Bates**, E.E.'76, for GenRad; **Chester M. Day, Jr.**, S.M.'58, for Bellcore; **Dean R. Collins**, S.M.'59, for Texas Instruments; **Martin I. Eiger**, S.M.'85, for Bellcore; **Neil M. Haller**, E.E.'61, for Bellcore; **Nancy M. Hartle**, S.M.'82, for Honeywell, E-O Division; **Tomohiro Hasegawa**, S.M.'85, for Hewlett Packard Medical; **Theodore M. Lyszczarz**, Ph.D.'79, for Lincoln Laboratories; **John T. Maxwell**, S.M.'81, for Xerox PARC; **Sara R. Murphy**, S.M.'69, for Digital Equipment Corp.; **Anthony M. Nicolli**, S.M.'85, for Honeywell E-O Division; **John R. Selin**, S.M.'70, for Raytheon; **Eric A. Slutz**, S.M.'75, for Hewlett Packard Laboratories; **L. Alan Snyder**, Ph.D.'79, for Hewlett Packard Laboratories; **John A. Yasaitis**, Ph.D.'74, for Analog Devices; and **Marc A. Zissman**, S.M.'86, for Lincoln Laboratories.

Graduates of the Institute, other than VI-A's, are also involved with the program, and a number of them attended our selection activities: **Lawrence W. Banks**, E.E.'70, for Hewlett Packard Medical; **David V. Burke, Jr.**, Ph.D.'72, for Draper Laboratories; **Delmer L. Fehrs**, Ph.D.'68, for Tektronix; **Robert M. Fiorenza**, '62, for IBM, Burlington; **Winthrop A. Gross**, S.M.'73, for Tektronix; **Michael D. Leis**, S.M.'66, for Digital Equipment Corp.; **J. Michael Milner**, '72, for AT&T Bell Laboratories; **Marion B. Reine**, Ph.D.'70, for Honeywell E-O Division; **James E. Rumbaugh**, Ph.D.'75, for General Electric, Schenectady; **Roger N. Wallace**, Sc.D.'72, for Raytheon; **Adrian C. Wang**, '85, for Schlumberger; and **Burnell G. West**, '60, for Schlumberger.

Visitors signing our guest book, not otherwise mentioned, included: **David Chiang**, S.M.'85, with Fairchild Research, Palo Alto, Calif.; **David A. Krall**, S.M.'83, of Arlington, Mass.; **C. Timothy Kuo**, S.M.'82, with Raytheon Co., Bedford, Mass.; and **Joel E. Schindall**, Ph.D.'67, president, Loral Data Systems, San Diego, Calif.—**John A. Tucker**, Director, VI-A Internship Program, M.I.T., Room 38-473, Cambridge, MA 02139.

VIII PHYSICS

The grade of Fellow in the American Physical Society came to 22 members of the M.I.T. community early this year, 15 of whom hold degrees from the department:

- **Gary C. Bjorklund**, '68, of IBM's research laboratories in San Jose, Calif., "for pioneering work in nonlinear optics and . . . laser spectroscopy."
- **Patrick H. Diamond**, Ph.D.'79, of the Institute for Fusion Studies at the University of Texas, Austin, "for important contributions to nonlinear plasma theory, plasma turbulence, and understanding of anomalous transport in toroidal, magnetically confined plasma."
- **Gail G. Hanson**, Ph.D.'73, of the Stanford Linear Accelerator Center, "for contributions to the discovery and study of new particles . . ."
- **Richard J. Hawryluk**, Ph.D.'74, of the Plasma Physics Laboratory at Princeton University, "for outstanding contributions to understanding plasma behavior in tokamak devices."
- **Shirley A. Jackson**, Ph.D.'73, of AT&T Bell Laboratories, New Providence, N.J., "for contributions to the theory of charge density wave inst-

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abilities, the channeling of heavy ions in solids, and the behavior of 2-D electronics on helium films."

□ **Frank E. Jamerson**, '48, head of the Physics Department at General Motors Research Laboratories, "for research in noble gas plasma physics and leadership in developing industry-university cooperation."

□ **Paul G. Langacker**, '68, associate professor of physics at the University of Pennsylvania, "for contributions to understanding modern elementary particle theory."

□ **Robert B. Laughlin**, Ph.D.'79, of Lafayette, Calif., "for insights into two-dimensional electrons in a magnetic field."

□ **Patrick A. Lee**, Ph.D.'70, "for contributions to the theory of many-body effects in condensed matter."

□ **Marc David Levenson**, '67, of IBM's research laboratories in San Jose, Calif., "for development and insightful application of novel techniques of nonlinear laser spectroscopy."

□ **Harold J. Metcalf**, '62, professor of physics at SUNY, Stony Brook, N.Y., "for contributions to the field of laser spectroscopy."

□ **Alfred H. Mueller**, Ph.D.'65, "for developing a 'factorization theorem' in field theory and its extensions."

□ **William D. Phillips**, Ph.D.'76, "for contributions to atomic physics and the determination of fundamental constants."

□ **John W. Shaner**, '64, group leader in shock-wave physics at Los Alamos National Laboratory, "for experimental research on material properties at extremely high dynamic temperatures and pressures."

□ **Clark W. White**, '62, of Oak Ridge National Laboratory, "for research on laser annealing of semiconductors, ion implantation, and ion-beam surface-layer analysis."

Professor **Robert J. Birgenau**, associate director of M.I.T.'s Research Laboratory for Electronics, was honored in March with the 1987 Olive E. Buckley Condensed Matter Physics Prize of the American Physical Society; his citation was for "use of neutron and x-ray scattering experiments to determine the phase and phase transitions of low-dimensional systems."

J. Edward White, Ph.D.'49, received the Maurice Ewing Gold Medal of the Society of Exploration Geophysicists at the organization's annual international meeting in Houston last November 5. White is a member of the geophysics faculty at the Colorado School of Mines. . . . **H. Henry**

Stroke, Ph.D.'55, reports, "In a collaboration with colleagues in France and at CERN, developed a new type of high-resolution particle spectrometer based on low-temperature calorimetry. The first results were presented in a recent issue of the British Journal *Nature*."

Four new teachers joined the department at M.I.T. last fall with the rank of assistant professor: **Edmund Bertschinger**, who studied astrophysics at Princeton for his Ph.D., is now teaching and studying theoretical astrophysics, including galaxy formation, gas dynamics, and the physics of the interstellar medium; **L. Gregor Herten** has been studying the physics of elementary particle interactions at CERN following his doctorate at Aachen; **Mehren Kardar**, Ph.D.'83, was a junior fellow at Howard University before returning to the Institute to work on theoretical condensed matter physics; and **Anesh Vasant Manohar**, who holds degrees from Harvard and Caltech, is interested in particle physics and statistical mechanics.

X CHEMICAL ENGINEERING

Robert A. Brown, Arthur Dehon Little Professor of Chemical Engineering at M.I.T., is on the Editorial Board of *The International Journal of Supercomputer Applications*, a new periodical from the M.I.T. Press.

Gabriel A. Avgerinos, S.M.'75, writes, "Re-

cently was promoted to head energy research and consulting at Poter and Partners, Inc. (885 Third Ave., New York City, 10022). Our services include advice to producing countries on marketing of energy commodities, special consulting projects and studies, and various multiclient publications in the energy and shipping industry." . . . **Robert L. Richards, Jr.**, Sc.D.'55, retired last December as vice-president, polymer products, at the Du Pont Co., Wilmington, Del., after 32 years of service. Richards joined Du Pont in 1954 as a research engineer at the Yerkes Research Laboratory, Buffalo, then held various manufacturing posts in the former Film Department, and was plant manager in Florence, S.C., before turning to polymer products in the 1970s. . . . **Donald W. Peaceman**, Sc.D.'51, of Houston, retired last February from Exxon Production Research Co. after 34 years of service. Peaceman is currently a consultant for J.S. Nolen and Associates.

Stephen C. Dodd, S.M.'76, writes, "In 1986 we moved into a new home and it has kept us very busy. I am still vice-president—research and development for the Davey Co., a manufacturer of binder's board for all hard-bound book manufacturers. In addition I am also the managing director of our Downingtown, Penn., plant." . . .

Herbert A. Epstein, S.M.'82, of Shell Oil's Norco Manufacturing Co., Norco, La., reports his involvement in the local section of the AIChE: 1986-87 chairman, 1985-86 vice-chairman, 1984-85 secretary, and 1983-84 treasurer. Epstein also served as social program chairman for the society's 1986 spring national meeting in New Orleans.

Charles P. Marion, Sc.D.'52, writes, "Retired January 1, 1986 after 33 years with Texaco, Inc., and Texaco Development Corp. As consultant, acted as chairman of the technical program for the 1986 symposium of licensees of the Texaco synthesis gas generation process. On retirement, TDC's president honored me with a plaque citing 'outstanding contributions spanning four decades in the field of partial oxidation technology'." . . . **Richard L. Bolin**, S.M.'50, reports, "I continue working on the development of export processing zones in the Third World. Jeanne and I spent September in Bangladesh and then saw the Himalayas in Nepal. Work was also done in Honduras during 1986."

XI URBAN STUDIES AND PLANNING

A \$400,000 two-year program of fellowships for graduate study at M.I.T. was announced last winter by Professor **Tunney Lee**, head of the department. The goal is to bring up to 12 top minority college graduates to Cambridge for graduate work in urban studies and planning next fall. It's hoped that grants providing full tuition and \$5,000 for living costs will make it possible for graduates, without the burden of substantial college debts, to work in minority communities where their talents are most needed.

Edwin Melendez, formerly assistant professor of economics and Puerto Rican studies at Fordham University, has joined the department at M.I.T. to work on government policies affecting people of color and Hispanics in the U.S.

William H. Johnson, S.M.'86, who wrote his thesis in the Center for Real Estate Development, has joined Crimson Industries, a real estate development company in Los Angeles, as vice-president—development. . . . **Dowell Myers**, Ph.D.'81, writes that he has joined the Real Estate and Urban Land Economics Department, School of Business, University of Wisconsin, Madison, thus proving that "the association between planning and real estate is a two-way street!" . . . **John Blackwell**, M.C.P.'47, writes, "Boston Natural Areas Fund, Inc., of which I am managing director, is now in its 10th year of helping save green spaces within the city of Boston. So far, nearly 200 acres are now open and green (or greenable) forever, and would not be, without our help. This year, financed by a Riley Founda-

tion grant, Boston Natural Areas Fund is very pleased to be working with the Dudley Street Neighborhood Initiative and several community development groups, notably Nuestra Comunidad, to help acquire land in a 450-acre pilot project area in Roxbury to assist and assure a balance of 'affordable' housing and related urban green spaces for long-term future benefit."

XII EARTH, ATMOSPHERIC AND PLANETARY SCIENCES

Peter Crowley, Ph.D.'85, moved back to Massachusetts last fall after accepting a job as an assistant professor in the Department of Geology at Amherst College. . . . **Julie D. Morris**, Ph.D.'84, whose M.I.T. degree is in geochemistry, will become a staff member of the Carnegie Institution of Washington next July 1. Morris is now a Carnegie postdoctoral fellow at the Institution's Department of Terrestrial Magnetism; her work is in the chemistry of volcanic rocks, using beryllium-10 as a tracer for the action of plate tectonics.

Faith Vilas, S.M.'75, writes, "Currently employed as a space scientist at the Johnson Space Center. I married Larry Smith on July 5, 1986."

. . . **Louis C. Raymond**, S.M.'32, reports that his book *Spindle Whorls in Archeology* is being introduced to colleges and universities. "Presently doing research on and trying to write up the historical Regna archeology dig (with help of others)," he adds. . . . **Mark E. Willis**, Ph.D.'83, reports, "I have been recently promoted to senior research geophysicist at Mobil Research and Development Corp., Dallas Research Laboratory."

Professor **Leonard W. Weis**, S.M.'47, writes from the Department of Geology at the University of Wisconsin at Menasha, "My wife Donna and I are in the group that formed 'Friends of the Hearthstone, Inc.', a charitable organization. Last fall we achieved our goal of buying the Hearthstone in Appleton. This is the first home lighted by electricity from a central hydroelectric generating plant, 1882." . . . **Joseph Karpen**, S.M.'73, was recently appointed vice-president for computer operations of Karpen Steel Products, Inc., Weaverville, N.C. . . . **Thomas F. Malone**, Sc.D., '46, scholar in-residence at St. Joseph College, West Hartford, Conn., is president-elect of Sigma Xi, the scientific research society; he will take office as president next October.

XIV ECONOMICS

Margaret Garritsen de Vries, Ph.D.'46, has retired as historian at the International Monetary Fund, Washington, D.C., after an association going back to 1946. . . . Professor **Raymond E. Willis**, Ph.D.'64, of the School of Business Administration, University of Minnesota, reports that his book, *A Guide to Forecasting for Planners and Managers*, was published in January by Prentice-Hall. . . . **Shinichi Ichimura**, Ph.D.'53, is a visiting professor at the Business School at Columbia University, lecturing on the economics of Japan and Pacific basin countries. Ichimura is on leave from the Center for Southeast Asian Studies at Kyoto University, Japan.

Michael R. Dohan, Ph.D.'69, associate professor of economics, is director of the Social Science Laboratory for Research and Teaching at Queens College of the City University of New York. The laboratory provides specialized support in microcomputer applications in the social sciences to students and faculty, and there is an active internship program in personal computer applications, technical support and laboratory management. . . . **Lawrence E. Hilbroad**, S.M.'60, a trader in its Government Securities Department, is now a managing director of Salomon Brothers, Inc., New York City. **Jeffrey M. Wooldridge**, who is completing his doctorate at the University of California at San Diego, has joined the department at M.I.T. as assistant professor; his

special interests are econometric estimators and dynamic pricing models.

Professor **Michael J. Piore** of M.I.T. will serve as a 1987-88 Phi Beta Kappa Visiting Scholar, making two-day trips at the invitation of local PBK chapters to lecture and confer with students and faculty at colleges and universities throughout the U.S.

XV MANAGEMENT

Virginia M. Sullivan, S.M.'84, was married on August 29, 1986 to Daniel Gilmour, a mechanical engineering graduate of the University of Michigan; she continues to work in worldwide product planning at GM, Detroit. . . . **Christopher W. Jenkins**, S.M.'86, is now vice-president of Arch Capital, Albany, N.Y., a radio communications company. . . . As vice-president of Strategic Planning Associates, Washington, D.C., **Dean Wilde**, S.M.'80, heads the firm's telecommunications practice. . . . **Berden Menkus**, S.M.'84, with McKinsey and Co., has transferred to London for one year. . . . **Guy Vancollie**, S.M.'83, writes, "In July Vivianne and I moved into our new Scandinavian-style house in Brasschaat, Belgium. We enjoy many nice summer days with our two daughters, Valerie and Evelyn. Last September I was promoted to the position of local engineering manager at Digital Equipment's Belgian subsidiary. Most of the work focuses on adapting software to the needs of the local market (languages, keyboards, programs, regulations, etc.)."

John F. Coburn, S.M.'80, writes, "Married former colleague Virginia Kelikian in April 1986. We are now living happily in Beverly, Mass."

Bruce W. Bean, S.M.'69, writes from Minneapolis: "As of 1985, I have become the president of Tartan Transportation Systems, Inc., a manufacturer of the 'Classic Ride' suspension systems for heavy-duty trucks. Tartan is a development-stage company with its manufacturing plant on the iron range of Northwestern Minnesota. We have made great progress with our unique, patented approach to suspension systems and can now reduce up to 71 percent of the shock and vibration occurring in these trucks." . . . **Laurence Klurfeld**, S.M.'72, has joined the Canaan Group, a small, start-up consulting group based in Greenwich, Conn. The firm focuses on operations and strategy for manufacturing companies, and its goal is to expand into new ventures after a solid base of business has been established.

Peter C. Lamb, S.M.'76, is a partner in Arthur Anderson and Co., Seattle, Wash., working in the Management Information Consulting Division. . . . **Beth Krasna**, who studied at the Sloan School in 1982-83 and then graduated from the Swiss Federal Institute of Technology, writes from Geneva that she is a partner for Genevest Consulting Group, a Swiss venture capital firm.

After 17 years as president, chairman, and chief executive officer at Rath and Strong, Inc., Lexington, Mass., **Arnold O. Putnam**, S.M.'47, has retired to be chairman emeritus. He now lives in Mattapoisett, Mass. . . . **Erika Williams**, S.M.'78, reports that she is still at Amdahl Corp., Sunnyvale, Calif., where she has recently been appointed vice-president, processor technology and development. Williams is also a member of the Board of Directors at Silicon Valley Bank. . . . **David J. Fullerton**, S.M.'78, on the staff of Bank of America, San Francisco, reports that he married Pamela Strike (Stanford '78) on September 20, 1986. . . . From **Ruth L. Clinton**, S.M.'79, of Estes Park, Colo.: "The entrepreneurship class has come back to haunt me. I'm starting a publishing enterprise, using a new desk-top publishing computer system. Seven student interns from my alma mater, Principia College, are now doing market research and business planning. First press run is scheduled this spring."

Georges H. Lecointe, S.M.'64, writes that he is spending this year in Singapore in charge of the office of PATT s.a. for technology transfer in

The dream of Martin Luther King—"that people can have three meals a day for their bodies, education and culture for their minds, peace and freedom for the spirit"—has been "shattered" by the conservative policies of the Reagan White House and the spirit of the country, says Julianne Malveaux, Ph.D.'80, assistant professor of economics at the University of California at Berkeley.

Superficially, there has been progress toward King's goals in the 1980s, said Malveaux. "But as long as the majority of women are working at clerical and service jobs and earn an average of \$264 a week, as long as a third of the black population is in poverty, we can talk about change, but we understand that it has not affected the majority," Malveaux told a Martin Luther King, Jr., Day audience at the University of Maine in Orono.

Though the Reagan administration is a major factor in the problem, replacing it with a more humane one will not be enough, Malveaux warned her audience. Liberals and democrats may want change, she said, "but they don't want change to be so earth-shaking that people become scared."

"Not only do we have to struggle with the current administration. We'll have to struggle with any administration that does not accept three meals a day, freedom, and education as basic rights." □

Southeast Asia. His regular assignment is at the company's headquarters in Brussels, Belgium.

. . . **R. Scott Morgan**, S.M.'76, writes a cryptic "Alive and well and living in California." . . . **Bernhard F. Mohr**, S.M.'70, of Uznach, Switzerland, writes, "Since August 1, 1986, I have been deputy director of the 700th Swiss Anniversary and Exposition, to be held in 1991 in the central part of Switzerland." . . . **Michael deMarco**, S.M.'68, is head of new product development for Citicorp's North American Investment Bank, New York City. . . . **Lawrence Salba**, S.M.'67, writes, "Still employed by Allied Automotive, nee Bendix, Southfield, Mich. Happily married with wife, Pam, and Ben (age 7) and Leslie (age 6)." . . . **Robert W. Adenbaum**, S.M.'50, is developing Palm Beach (Fla.) industrial Park with over 100,000 square feet of hi-tech industrial space on Interstate 95, West Palm Beach."

Howard S. Krasnow, S.M.'58, writes, "Daughter Amy became M.I.T. alumna with a master's in architecture last June. We 'enjoyed' the wet ceremony." . . . **Howard Mandelbaum**, S.M.'65, was recently appointed executive vice-president of William Douglas McAdams, New York City, the largest independent health-care advertising agency in the United States. . . . **John E. Paap**, Ph.D.'79, writes, "In October I joined Venture Economics, Wellesley Hills, Mass., a consulting company specializing in venturing—from venture



Julianne Malveaux

Speaking to a Martin Luther King, Jr., Day audience at the University of Maine, Julianne Malveaux, Ph.D.'80, of the University of California at Berkeley accused President Ronald Reagan of bringing about "a meanness in this country, a lack of generosity, the ability for people to walk by the homeless without understanding that there but for the grace of God go I. Clearly, more and more people will experience poverty . . . unless we take great pains to restructure the social and economic arena," Malveaux said.

capital to strategic partners, to internal ventures. As associate director of corporate consulting, am providing assistance to corporations in areas of planning and implementing venturing activities." . . . From **John P. Leake**, S.M.'84: "I was promoted to the rank of major, U.S. Army last June. I am currently in my third year at West Point, where as an assistant professor I teach management and mathematics subjects to cadets. The assignment here has been thoroughly enjoyable."

William M. Fondren, Jr., S.M.'63, is completing his sixth year as president, Orgill Brothers and Co., Inc., Memphis, Tenn., regional distributor of hardware and floor covering. The firm employs 625 and delivers products into 17 states. Fondren was recently elected board chairman of Liberty Distributors, Inc., Chicago, a company providing buying and marketing services to member distributors nationally. . . . **Ernest I. Glickman**, S.M.'64, has been promoted from executive vice-president to president and chief operating officer of Harbridge House, Inc., Boston, a 35-year-old international management consulting firm that he joined in 1967. . . . **Thomas C. Gaputis**, S.M.'73, is a partner in the Consulting Division of Arthur Anderson and Co., Tampa, Fla. Gaputis is responsible for the firm's manufacturing and distribution practice in Central/North Florida. He, his wife Carol, and son Keith reside in Safety Harbor.

Martin Sees Clouded Energy Future



William F. Martin

marked copy
Are today's low oil prices that discourage domestic exploration granting the OPEC nations a mortgage on the future of the U.S.? And if so, what can we do about it?

The question of future energy security is high on the agenda of William F. Martin, S.M.'74, deputy secretary of the U.S. Department of Energy (DOE), and for the short-range future he's optimistic. Thanks to conservation, U.S. energy consumption is far below the forecasts of less than a decade ago, and it will stay down. "The importance of market forces in determining energy consumption is one of the great lessons of the past decade," Martin told members of the International Association of Energy Economists meeting at M.I.T. late last year.

When it comes to the longer-range fu-

ture—beginning in the 1990s—Martin harbors concerns that he shared with his energy-economist colleagues. "Washington is a new, tough place today," he said. The Gramm-Rudman pressure for deficit reduction means that "you have to justify everything, to show how every program is a better way to spend money than the alternatives."

For example, Martin said, Gramm-Rudman deficit-cutting prevents buying oil to add to the national petroleum stockpile at the rate the DOE would prefer, despite today's rock-bottom oil prices. But stockpiling is one of Martin's favorite strategies for disarming future energy shocks, and he hopes other nations will do what we cannot do.

What about a tax on oil imports to raise money that cannot come from today's federal budget? To stimulate domestic exploration and production, said Martin, such a tariff would have to be at least \$10 per barrel, and it would have the added advantage of providing funds to buy oil for stockpiling. But he believes that a tax at that rate is politically unfeasible because of the high cost it would impose in the economy. Today's consumer is pocketing the benefits of low oil prices, Martin says, and there can be no consensus for an oil tariff "at a time when the public doesn't care."

Martin is chairing a review of energy-related national security concerns, and a report was submitted to the president in mid-March. □

John F. Rockart, director of the Sloan School's Center for Information Systems Research, is a member of the selection committee for the Society for Information Management's first Partners in Leadership Award. The prize, honoring two top executives who have succeeded in bridging the gap between the nontechnical and technical at the top of a company to achieve effective business applications of information systems, will be presented at SIM's 1987 annual meeting next fall in Seattle.

A near-record eight new assistant professors joined the Sloan School faculty last fall: **Ravindra K. Ahuja**, on leave from the Indian Institute of Technology in Kanpur, is working on network flow problems; **Ravi Bhushan** is trained as a nuclear engineer and will complete his doctorate thesis on financial information dissemination at the University of Chicago; **Michael A. Cusumano** is studying software engineering management in Japan and the U.S. after completing his Harvard Ph.D. two years ago; **Kenneth A. Froot**, an economist who was formerly a consultant to the World Bank, is studying exchange rate determination; **Frank R. Kardes**, trained as a psychologist at Indiana University, is working on consumer information issues; **Peter J. Kempthorne** is a specialist in statistics and statistical modeling on

leave from Harvard's Department of Statistics; **Don H. Kleinmuntz**, formerly on the faculty at the University of Texas in Austin, is interested in cognitive and decision-making processes; and **Robert J. Thomas**, formerly a teacher at Boston College and the University of Michigan, is a specialist on the impact of technological change on human resource management.

Sloan Fellows

James J. Markowsky, S.M.'81, has been promoted from assistant vice-president to vice-president—mechanical engineering at American Electric Power Service Corp., Columbus, Ohio. . . . The consulting business of **LeRoy E. Day**, S.M.'60, (LeRoy E. Day and Associates, Rockville, Md.), continues to expand. Day specializes in the commercialization of space, and he recently lectured in the People's Republic of China, Thailand, and Japan on space and the management of large, high-technology programs. . . . From **James F. Walsh**, S.M.'56, of Mt. Laurel, N.J.: "Retired June 30, 1985. Nan and I are enjoying ourselves by traveling and spending more time with our sons' families and seven grandchildren in Trumbull, Conn., Dover, Del., and Raleigh, N.C."

Senior Executives

Roger P. Onorati, '82, reports, "I retired after 25 years with the United States Navy and took a position as operations manager with M. Polaner, Inc., Roseland, N.J., who makes 'the world's greatest jelly.' My wife Judy and I now live in Mountain Lakes, N.J." . . . **William D. Betts**, '73, is continuing as energy manager at Dow Corning Corp., Midland, Mich.

Three deaths have been reported to the Alumni Association, with no further details available:

Donald M. Mounce, '57, of Cedar Rapids, Iowa, on June 14, 1986; **Irving Zuckerman**, '69, of Palos Verdes Estates, Calif., on March 24, 1986; and **Hermann J. Grabherr**, '72, of Planegg, West Germany, on November 4, 1986.

Management of Technology Program

Milt Baker, S.M.'86, visited the Program office in January while here on business. (Milt is the manager of strategic technical management in advanced engineering at General Motors Corp.) The Baker family is fine and glad to be back in their own home; however, Milt said it felt like coming home to be back here at M.I.T.

Peter Drummond, S.M.'85, manager of sales and marketing at Lucas Engineering and Systems, Ltd., called last February to say hello. A colleague of Peter's will be visiting us in March. . . . Professor **James Utterback** was delighted to have **Ed Gilbert**, S.M.'86, speak to his Manufacturing/Technology Interface class last March. Ed is general manager of R&D at Carpenter Technology Corp. He stayed after his talk to enjoy lunch with the current class of MOTs. Ed reported that **Jim Rogers**, S.M.'86, will be speaking to a group at Carpenter Technology on CIM. Jim is advisory industry specialist at IBM Corp.

Jacalyn Walker-Sharp received a newsy letter from **Jack Jarkvik**, S.M.'86, last February. Jack said that he and his family enjoyed several weeks in California before returning to Sweden last summer, and once home Jack relaxed for the month of July (which cooperated by offering perfect weather) before returning to Ellemtel, a subsidiary of Ericsson. Jack has recently taken a new job: overall project manager of an ISDN project with Ericsson Telecom. His project is installing a commercial network of ISDN exchanges in all the state capitals in Australia.

Anita Kirkpatrick, S.M.'85, has taken a position as biotechnology patent specialist with Knobbe, Martens, Olson and Bear, Newport Beach, Calif. Anita writes that she plans to attend law school next fall. . . . **Drew Peck**, S.M.'85, called to let us know that he's now with Donaldson, Luftkin, and Jenrette. He and Liz plan to move to New York City in the near future. Drew doesn't care for commuting and Liz is anxious to be back in the city!

We heard from **Katherine Rowe**, S.M.'86, last March. She's almost finished the computer system project she has overseen since her return to Physio-Control Corp. This past summer and is excited about working on CIM in the near future.

. . . **Kim-Chinh Tran**, S.M.'86, reports that he's travelling quite a bit in his position as principal, technology acquisitions, Westinghouse Electric Corp. He just closed an acquisition in California and was very thankful to have the knowledge he gained in his accounting, finance, and marketing course.—Jacalyn Walker-Sharp, Program Coordinator, Management of Technology Program, M.I.T., Room E52-125.

XVI AERONAUTICS AND ASTRONAUTICS

Uriel Preiser, S.M.'84, is a research staff member at the Institute for Defense Analyses, Alexandria, Va. . . . **Dennis K. McLaughlin**, Ph.D.'70, reports that as of September 1986 he has been professor and head of the Aerospace Engineering Department at Pennsylvania State University. . . . **Ro-**

bert F. Weiss, S.M.'59, writes, "Physical Sciences, Inc., is now in its 14th year and 100 employees strong. I'm located in Andover in our new facility when working; in Lynnfield when not. Major hobby: elder housing development and consulting. Family is well; one graduate, three to go!"

... From **Norman M. Haller**, S.M.'62: "I recently retired after 30 years of military and civilian service with the U.S. Air Force, Office of the Secretary of Defense, and Nuclear Regulatory Commission. I have started my own consulting business, Norm Haller Associates, Inc., Vienna, Va., specializing in energy, national defense, and general economic/management analyses."

Robert A. Summers, Sc.D.'54, reports, "Since April 1984 have been chief, Verification Division, United States Arms Control and Disarmament Agency, Washington, D.C. As you can imagine, the pace in arms control has picked up considerably the past year or so. Sherma and I now have twin daughters as sophomores in college and a son who is a freshman in high school." ... **Carl Alexoff**, S.M.'56, of Cherry Hill, N.J., and his wife Marlene attended the 16th Congress of the Association Internationale des Lotteries D'Etat in Istanbul, Turkey, last fall. After the Congress, they toured Gallipoli, Troy, Izmir and Ephesus.

Marc L. Sabin, Sc.D.'73, of East Northport, N.Y., is assistant to the vice-president, advanced systems and technology, at the AIL Division of Eaton Corp., responsible for program management. ... **Vivekananda Mukhopadhyay**, Sc.D.'72, joined George Washington University as associate professor in the NASA/GWA Joint Institute for Advancement of Flight Sciences at NASA Langley, Hampton, Va.

Wilford M. ("Wiley") Post, Jr., '36, who graduated in the course in General Engineering, has been honored by a scholarship fund in his name, created by the Northeast Chapter of the American Association of Airport Executives. A minimum of \$1,000 will be provided annually to a college junior or senior working toward a bachelor's degree in aviation management. Post was manager of the Allentown-Bethlehem-Easton (Pa.) Airport before his retirement in 1984, a charter member of the Northeast Chapter, and widely honored for his achievements in the field. He now serves as an aviation consultant based in Allentown.

As its annual meeting concluded in Chicago last February, Professor **Shiela E. Widnall**, Sc.D.'64, of M.I.T. took reins of the American Association for the Advancement of Science as its president for 1987-88. Two months earlier she was elected a director of Aerospace Corp., El Segundo, Calif. Widnall also serves on the boards of Chemical Fabrics Corp. and the Carnegie Corp.

Morris Neiburger, '41, of Palo Alto, Calif., passed away in 1986; no further details are available.

XVII POLITICAL SCIENCE

Peter M. Haas, Ph.D.'86, has been named assistant professor of political science at the University of Massachusetts, Amherst, specializing in international relations, science, technology and public policy. Prior to this appointment, Haas spent six years as a research assistant while completing his doctorate in the department at M.I.T.

XVIII MATHEMATICS

Stephen W. Boyack, Ph.D.'85, returned to M.I.T. early this year for a day of recruiting for his present employer—including a two-hour public seminar on "Mathematics Opportunities at the National Security Agency."

Five new assistant professors were made welcome by the department at M.I.T. last fall: **Baruch Averbach**, who holds three degrees from Technion at Haifa, Israel, is interested in distributed and parallel computation, graph algorithms, and

cryptography; **Luis Casian**, Ph.D.'83, a native of Mexico, is studying Lie groups and Lie algebra; **Haynes R. Miller**, formerly at Notre Dame and the University of Paris, is also working on compact Lie groups and allied spaces; **Ali Nadim**, S.M.'85, is completing a doctorate in chemical engineering at M.I.T. while teaching fluid and continuum mechanics and transport phenomena; and **Stephanie Zaliski** is studying turbulence, thermal convection, and other dynamic systems.

Faculty ranging from philosophers to engineers come together at Tufts University in the Norbert Wiener Forum, described for a recent New England IEEE meeting by Professor **David Isles**, Ph.D.'64, of the Tufts Department of Mathematics. The group takes its inspiration from the concern for human implications of technology attributed to the late Norbert Wiener; we "explicitly question the belief in 'technological determinism,'" says Isles. "The group believes that before analyzing a new technology, one must be clear about the human and social objectives it is meant to serve." There is correspondence with a similar forum at Kokai University, Tokyo, to observe how cultural values and national priorities affect technology assessments in the two countries.

XX APPLIED BIOLOGICAL SCIENCES

Eirik Nestaas, Ph.D.'81, director of research for Petroferm Research, Inc., is the biotechnology expert in a Petroferm project to develop new microbial surfactants to ease the passage of semisolid fluids through pipelines. The idea is to form long-lived emulsions of the semisolid with lighter, more fluid materials; a biotechnology-based ingredient makes Petroferm's emulsan form emulsions that resist coalescence. Writing in *Chemtech*, Nestaas and his co-workers propose that these new products will permit the passage of heavy crude oils through pipelines, thus permitting economical exploitation of large heavy crude resources throughout the world.

Jeffrey P. Bernstein, S.M.'76, graduated from the University of Louisville School of Medicine in 1981 and since 1985 has been in private practice in psychiatry in Albany, N.Y. ... **Elizabeth A. Williams**, Ph.D.'76, started her residency in internal medicine at Emory University last January 1 after completing internship at East Tennessee State University. ... **Barbara J.S. Greenberg**, S.M.'77, writes, "I am still employed by the New York State Department of Health, recently promoted to director of Nutrition Program Services and assistant director of Supplemental Food Programs. The majority of my time is devoted to planning, implementation, and evaluation for the management of over \$155 million in program funds. My M.I.T. training in the International Nutrition Planning Program is finally being put to good use."

XXII NUCLEAR ENGINEERING

Nathan O. Siu has joined the department at M.I.T. to continue work in probabilistic risk analysis for nuclear power plants that he began with Pickard, Lowe, and Garrick, Inc., following his graduate studies at the University of California at Los Angeles.

Beyond National Borders by **Kenichi Ohmae**, Ph.D.'70, was a best-seller within days of its appearance in Japan in 1986. Now it's available in the U.S.—"a rare opportunity for American readers to listen in on a ... debate that could change Japan's future," says the American publisher, Dow Jones-Irwin. Just as imports threaten Americans' jobs, so they now threaten the Japanese—raising the spectre of protectionist policies everywhere. In his book, Ohmae appeals for a world view, showing how jobs and free trade can co-exist.

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M. J. Barvenik, '76
D. M. Brown, '81
M. D. Bucknam, '81
N. A. Campagna, Jr., '67
F. W. Clark, '79
K. A. Fogarty, '81
W. E. Hodge, '79
C. A. Lindberg, '78
R. T. McGillivray, '68
C. A. Mendez, '85
J. D. Okun, '75
K. J. O'Reilly, '80
R. M. Simon, '72
T. von Rosenzweig IV,
'80
W. G. Williams, '65
D. W. Wood, '76

OBITUARIES



B.S. Gould



E.N. Hartley



E.W. Boehne

Bernard S. Gould, 1912-1987: Champion of Undergraduate Biologists

Professor emeritus Bernard S. Gould, '32, was for many years a notable champion and principal adviser for many biology and premedical undergraduates at M.I.T. He died on February 11, ten years after he retired from full-time work as professor of biochemistry; he was 75.

Gould joined the faculty in 1938, four years after completing his Ph.D. in biochemistry at the University of London. His principal research was on the biochemistry of wound healing and tissue regeneration and the role of vitamins in these processes; he also studied the mechanisms of anti-bacterial agents. He was a consultant to several companies and to the Massachusetts Eye and Ear Infirmary on biochemical problems, and he served as a visiting lecturer in the field at the Boston University School of Advanced Dentistry.

But Gould is remembered especially for his roles in supporting undergraduates as the Institute's official premedical adviser as well as his department's undergraduate adviser.

Gould is remembered in the Boston Jewish community for his active role in Combined Jewish Philanthropies, the Jewish Vocational Service, and Jewish Family and Children's Service; he was also treasurer of the M.I.T. Hillel Foundation. Gould's wife, Sophie (Ginzberg), M.C.P.'37, died in 1985. □

E. Neal Hartley, 1914-1986: Historian and M.I.T. Archivist

Professor Emeritus E. Neal Hartley, who retired in 1977 after 30 years as an advocate of the humanities at M.I.T., died in Fairfield, Conn., on December 26, 1986; he was 72.

Hartley came to the Institute in 1946 as instructor in English and history after receiving bachelor's and master's de-

grees from Harvard and World War II service in naval intelligence. Ten years later, having become associate professor, Hartley and his wife, the former Charlotte Dexter Corlew, began a two-year assignment as faculty residents in Burton House. He was acting head of the Humanities Department in 1958 and secretary of the faculty for five years beginning in 1966. In that year Hartley was also named Institute archivist, to take charge of a growing effort to organize and make accessible the Institute's history. Hartley was also instrumental in establishing the M.I.T. chapter of Phi Beta Kappa, serving as president in 1974-75.

A specialist in the history of science and technology, Hartley had a leading role in the restoration of the first iron works at Saugus, Mass. He was official historian of the bicentennial activities in Concord, Mass., where the Hartleys made their home. □

Eugene W. Boehne, Sr., 1905-1987 Former Head of Course VI-A

The Department of Electrical Engineering and Computer Science—and especially its cooperative Course VI-A—lost a staunch supporter on February 22 in the death of Professor Emeritus Eugene W. Boehne, E.E.'40; he died in Cambridge at the age of 81 after a long illness.

Boehne, a native of Beaumont, Texas, first came to M.I.T. for graduate study following undergraduate work at the Texas A&M University (B.S. 1926). After receiving a Master's degree from the Institute in 1928, he joined General Electric Co., where he was in charge of the M.I.T. students on work-study programs. Boehne returned to M.I.T. in 1948, having completed a doctorate at Texas A&M, to head the VI-A program as associate professor and later professor of electrical engineering. His technical work was in high-voltage electrical

transmission, and he held the 1973 Hershaw Award for work in this field.

Leaving M.I.T. in 1960, Boehne worked for 10 years with ITE-Circuit Breaker Co. (now Gould, Inc.) and then made his retirement home in Florida. □

Wolcott A. Hokanson, 1901-1986

Wolcott A. Hokanson, whose name appeared at the bottom of countless M.I.T. documents as assistant bursar and bursar for 30 years, died in Brunswick, Maine, on December 31, 1986; he was 86.

Hokanson came to the Institute in 1915 as an errand boy for the Bursar's Office; he rose to assistant bursar in 1934 and bursar 20 years later. He retired in 1965. An active 32nd degree Mason, Hokanson was a long-time officer of the Richard C. MacLaurin Chapter at M.I.T. He also served for an extended period as assistant treasurer of the American Academy of Arts and Sciences.

For much of his 50 years at M.I.T., Hokanson's presence was a constant at the Institute: he and Ms. Hokanson, who was also a member of the staff, lived in Bexley Hall, and Hokanson made himself available whenever needs arose, day or night. Especially to recognize his emergency services to students and alumni, Hokanson was made an honorary member of the Alumni Association in 1954. □

Gaynor H. Langsdorf, 1908-1987

Gaynor H. Langsdorf, S.M.'32, who was manager of the Executive Development Department at Standard Oil Co. of California at the time of his retirement in 1973, died in San Mateo, Calif., on February 25; he was 79.

Langsdorf's career in the oil industry began with graduation from M.I.T. in chemical engineering. He returned in 1940-41 in one of the first classes of Sloan

Fellows to earn a master's degree in management. Thereafter, Langsdorf made major commitments to M.I.T.: He was active in two capital fund programs, a long-time member of the Educational Council, and a leader in the M.I.T. Club of Northern California. His service earned the Alumni Association's Bronze Beaver in 1964. □

Deceased

The following deaths have been reported to the Alumni Association since the *Review's* last deadline:

Hallet R. Robbins, '05; 1986; Phoenix, Ariz.
William Craig Ferguson, '09; December 8, 1987; Walla Walla, Wash.
Warren E. Glancy, '13; October 28, 1986; Burlington, Mass.
Charles L. Crosier, '16; January 29, 1987; Rocky Hill, Conn.
Harmon E. Keyes, '16; February 16, 1985; Tempe, Ariz.
Moses Wolk, '16; February 6, 1987; Brookline, Mass.
Benjamin H. Bristol, '19; January 18, 1987; Foxboro, Mass.
Robert A. Miller, '20; January 20, 1987; Rumson, N.J.
George A. Wilson, '20; November 30, 1986; Braintree, Mass.
Gladys F. MacDonald, '21; January 16, 1987; Auburndale, Mass.
Herbert K. Nock, '21; January 23, 1987.
Patrick H. Timothy, Jr., '21, 1983; New Orleans, La.
Robert E. Waterman, '21; January 31, 1987; Delray Beach, Fla.
Aubrey K. Nicholson, '22; January 4, 1987; Stuart, Fla.
Laurence E. Barstow, '23; October 6, 1986; Flint, Mich.
Jason T. Bickford, '23; November 21, 1986; Nashua, N.H.
Calvin M. Bolster, '23; December 3, 1986; Alexandria, Va.
Alexander F. Newman, '23; September 8, 1986; Flushing, N.Y.
Ruben H. Klainer, '24; October 2, 1986; Brookline, Mass.
Wilmot G. Peirce, Jr., '24; September 22, 1986.
Charles L. Reed, Jr., '24; August 31, 1986; Wilmington, Del.
Paul F. Carver, '25; November 19, 1986; Swampscott, Mass.
Gilbert L. Delugach, '25; December 28, 1986; Memphis, Tenn.
John C. Dunbar, '25; June 1, 1986; Kendall, Fla.
Edward W. Eager, Jr., '25; June 28, 1986; Newark, Del.
Edward D. McLaughlin, '25; February 23, 1987; Melrose, Mass.
Frederick P. Broughton, '26; November 6, 1986; Wayne, Penn.
Thomas R. MacDonald, '26; December 26, 1986; Rockledge, Fla.
Earl C. McMahon, '26; January 15, 1986; Duxbury, Mass.
Frederick L. Geary, Sr., '27; December 19, 1986; Springfield, Mass.
Parke A. Hodges, '27; February 16, 1987; Cambridge, Md.
John L. Locke, '27; December 22, 1986; Concord, N.H.
Edward Sanel, '27; January 27, 1987; Silver Spring, Md.
Mrs. Edward D. True, '27; February 28, 1986; Bath, Maine.
Wayne B. Wagar, '27; January 21, 1987; Mt. Pleasant, Mich.
Bella Alimansky, '28; February 1987; Delray Beach, Fla.
Eugene W. Boehne, Sr., '28; February 22, 1987; Sarasota, Fla.

Al(lbert) Starke Dempewolf, '28; January 29, 1987; Charlotte, N.C.
Arthur J. Bearse, '29; February 14, 1987; Punta Gorda, Fla.
Emanuel B. Hersberg, '29; January 22, 1987; West Orange, N.J.
John J. O'Brien, '29; January 12, 1987; Watertown, Mass.
Pablo I. Dejesus, '30; February 27, 1986; Malabon, Philippines.
Vito F. Cappello, '31; December 29, 1986; Sarasota, Fla.
Gabriel S. Cristofalo, '31; November 10, 1986; Miami, Fla.
Paul T. Semple, '31; December 18, 1986; Washington, D.C.
Bernard S. Gould, '32; February 11, 1987; Brookline, Mass.
Walter J. LeFevre, '32; January 27, 1987; Midland, Mich.
Charles G. Anderson, '33; October 3, 1986; South Bend, Ind.
Russell J. Brooks, '33; February 9, 1986; Atlanta, Ga.
Richard F. Warner, '33; 1986; Falmouth, Mass.
Clarence D. Davis, '35; January 26, 1987; San Diego, Calif.
Frank Chauncey Whittelsey, '35; August 1986; Barrington, R.I.
Walter G. Bain, '36; February 25, 1987; Guilford, Conn.
Mary J. Montgomery, '37; December 25, 1986; Knoxville, Tenn.
Eric D. Swenson, '37; February 9, 1987; Darien, Conn.
James B. Wagstaff, '37; December 8, 1986; Murrysville, Penn.
Edward T. Armstrong, '39; May 30, 1984; Butler, N.J.
Floyd A. Hansen, '39; May 1986; Arlington, Va.
Creighton B. Olson, '39; December 8, 1986; Mechanicsville, Md.
Walter H. Pulsifer, Jr., '39; November 24, 1986; North Abington, Mass.
Howard H. Reynolds, '39; 1976; Belmont, Mass.
Lester Lees, '40; November 10, 1986; Altadena, Calif.
Albert W. Kusch, '41; January 24, 1987; Flintridge, Calif.
Morris Neiburger, '41; 1986; Palo Alto, Calif.
Edward C. Cavey, Jr., '42; February 15, 1987.
William Devine, Jr., '42; February 17, 1987; Gaithersburg, Md.
Hartley Sargent, '42; December 27, 1986.
Maxcy D. Daggett, Jr., '46; January 6, 1987; Dallas, Tex.
Edward J. Walz, Jr., '49; 1986; Asheville, N.C.
Mark Baxter, '50; October 11, 1986; Fort Lauderdale, Fla.
Howard P. Hayden, '50; January 15, 1987; Shelburne, Vt.
Donald M. Surgenor, '52; January 20, 1987.
James L. Forstner, '53; December 26, 1986; Aiken, S.C.
Luther B. Wallace, '53; September 21, 1986; Palm Springs, Calif.
William F. Lipman, '54; 1986; Baltimore, Md.
Charles F. Cheney, '57; January 6, 1987; Rancho Palos Verdes, Calif.
Paul G. Carpenter, '58; December 16, 1986; Baton Rouge, La.
Theodore J. Nagel, '61; 1986; Green Valley, Ariz.
George H. McDaniel, '62; December 13, 1986; Cranford, N.J.
Robert K. Pollak, '64; June 1986; Orinda, Calif.
Anthony H. Robinson, '64; January 19, 1987; Atlanta, Ga.
Douglas M. Sheppard, '64; February 3, 1987; Edmonton, Canada.
Rodney J. Grettein, '74; August 1986; East Brunswick, N.J.
Herman W. Pettiford, '76; October 22, 1986; Rockville, Md.
Scott P. Bernard, '78; July 18, 1986; New York, N.Y.
Morris E. McCrary, '84; October 20, 1986; Roanoke, Va.
Peter K. Meic, '87; February 2, 1987; Mays Landing, N.J.

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Edward B. Kinner '67
Douglas G. Gifford '71
Joseph J. Rixner '68
John P. Dugan '68
Kenneth L. Recker '73
Mark X. Haley '75
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PUZZLE CORNER ALLAN J. GOTTLIEB

marked copy has been sent by J.M. 5/19

Stacked Deck and Houdini Polyhedra

Warren Seamans, director of the M.I.T. Museum, notes that the puzzle exhibition mentioned in the Feb/Mar issue will be showing at the Hudson River Museum in Yonkers, N.Y. from 6 April through 27 June.

Since it has been a year since I reviewed the criteria used to select solutions for publication, let me do so now.

As responses to problems arrive, they are simply put together in neat piles, with no regard to their date of arrival or postmark. When it is time for me to write the column in which solutions are to appear, I first weed out erroneous and illegible responses. For difficult problems, this may be enough; the most publishable solution becomes obvious. Usually, however, many responses still remain. I next try to select a solution that supplies an appropriate amount of detail and that includes a minimal number of characters that are hard to set in type. A particularly elegant solution is, of course, preferred. I favor contributions from correspondents whose solutions have not previously appeared, as well as solutions that are neatly written or typed, since the latter produce fewer typesetting errors.

Problems

M/J 1. Jim Landau writes that a friend of his, Allen Beadle, was in a bridge game with a certain timid (but nevertheless highly conceited) bridge player who refused to play finesses. Deciding that this player should be taught a lesson, Allen slipped in a stacked deck. The conceited player found himself holding a hand that contained the maximum possible number of finesses, all of which would be successful. You are to reconstruct the hand assuming spades are trump.



SEND PROBLEMS, SOLUTIONS, AND COMMENTS TO
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10012.

M/J 2. Bruce Calder wants to know the pressure due to gravity at the center of a spherical heavenly body of uniform density, mass M , and radius R .

M/J 3. Nob Yoshigahara has nine single-digit numbers with sum 45 and product 362880. What are they? One solution is (1,2,3,4,5,6,7,8,9). Can you find any other?

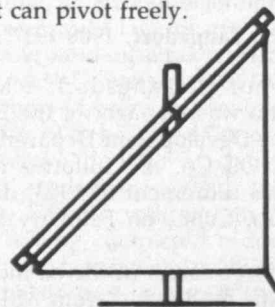
M/J 4. Matthew Fountain asks for the axes of the largest (in area) ellipse that can be inscribed in a triangle having sides of length 3, 4, and 5 inches.

M/J 5. Albert Mullin entitles the following problem *On Houdini Polyhedra*: Through which regular polyhedra can one carve a hole such that another regular polyhedron of the same size and type can pass? For example, clearly a cube with unit edge can pass through a suitably cut hole in another cube with unit edge.

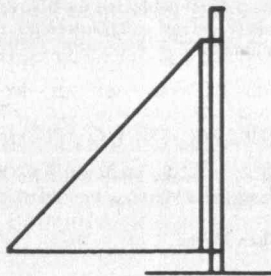
Speed Department

SD 1. Edward Lynch thinks that the sum of the integers from 1 to x is $x^2/2$. What is the smallest integral value of x (greater than 1) such Mr. Lynch's error is within 10 percent? Within 1 percent?

SD 2. Jim Landau claims to have canvassed his office looking for speed problems and found this one from George Claxton. On a boat with a "lateen rig" the sail is attached to a "lateen yard," which is attached to a vertical mast so that it can pivot freely.



On a "Marconi-rigged" boat, the sail is attached directly to the vertical mast.



Both rigs use triangular sails. One advantage of the lateen rig is that you can hang the same sized sail on a shorter mast. Let the sail be in the shape of an isosceles right triangle and assume that the lateen yard is attached at its center to a mast 2 meters high. How tall a mast would be needed on a Marconi-rigged boat for the same sail?

Solutions

JAN 1. Find the minimum number of high card points needed by a bridge partnership in order to insure making a 7NT contract.

For this problem the challenge seemed to be how to interpret the problem. In particular, for a given point count, are we to find the most favorable or least favorable card placement? Ron Adelsman found a hand where the partnership has all 40 points but cannot even make 6NT:

♠ A K
♥ A K
♦ A K Q
♣ A K Q J 4 3

♠ 10 9 8 7 6 5 4
♥ 10 9 8 7 6 5
♦ —
♣ —

♠ Q J 3 2
♥ Q J 3 2
♦ J 4 3 2
♣ 2

John Woolston found a hand where the partnership has only 11 points and yet makes 7NT against any defense:

♠ A
♥ A Q J 10 9 8 7 6 5 4 3 2
♦ —
♣ —

♠ K Q J 10 9 8 7 6 5 4 3 2
♥ K
♦ —
♣ —

♠ —
♥ —
♦ —
♣ —

♠ —
♥ —
♦ A K Q J 10 9 8
♣ A K Q J 10 9

Jim Landau notes that if you can distribute the cards at will for the partnership but not for the opponents, then 19 points are required. This can be done by taking the previous example and giving North the other two aces.

Also solved by John Woolston, Matthew Fountain, Michael Bushnell, Ron Adelman, Steve Strauss, Turner Gilman, Bill Huntington, Winslow Hartford, and the proposer, John Boynton.

JAN 2. Given a regular tetrahedron whose edges are L units in length. What is the value of L if the number of units of volume of the tetrahedron is equal to the sum of the number of units of length of all edges?

The volume of a pyramid is $\frac{1}{3} \times \text{base} \times \text{height}$. For a regular tetrahedron, the faces are all equilateral triangles, so the area of the base is $(L^2\sqrt{3})/4$, where L is the length of an edge. To find the height, a cross-section is taken of the tetrahedron. The base of the triangle thus formed is $(L\sqrt{3})/2$, which is divided into two parts by the altitude, $(L\sqrt{3})/6$ and $(L\sqrt{3})/3$. The corresponding sides of the triangle are $(L\sqrt{3})/2$ and L . The Pythagorean Theorem gives the altitude of $(L\sqrt{6})/3$. This gives the tetrahedron a volume of $(L^3\sqrt{2})/12$. When this is set equal to the sum of the length of all the edges ($6L$), L is found to equal $6\sqrt{2}$ or 7.13524269...

Also solved by Alan Taylor, Arthur Kaplan, Avi Ornstein, Jim Rutledge, John Woolston, Ken Rosato, Mary Lindenberg, Ray Kinsley, Steve Feldman, Matthew Fountain, Jim Landau, Winslow Hartford, and the proposer, Phelps Meaker.

JAN 3. Find the next term in the sequence 11, 2, 3, 41, 5, 61, 7, 83, ...

The i th term is the smallest prime using only digits from 1 to i . If, like Jim Rutledge, you require the i th term to start with the digit i , then the answer is 97. If, like Matthew Fountain, you do not make this requirement, then the answer is 19.

Yet another possibility exists as evidenced by Roger Milkman's solution; he writes from the University of Iowa:

I was astonished to learn of the existence of another analyst of the history of "scholar athletes." Walter Nissen is obviously referring to those Most Valuable Players on Iowa football teams whose numbers corresponded exactly with the number to times they attended class. This occurred nine times between 1907 and 1979, though not in the order given. The missing number is 97, whose name is lost in his academic exploits. He was named to the Big Ten all-academic team, did research on *recA* (a gene important in recombination in *E. coli*), and got a degree in theology. These last two achievements together account for his cognomen, *recA* theol. 97. The fact that this question was even proposed suggests that there are others who will know its answer, but who else will have a mind sufficiently recondite to note that the sequence also contains the smallest prime beginning with each of the digits 1 through 8 (and now 9) in ascending order?

Also solved by Roger Milkman, Steve Feldman, Arthur Kaplan, John Upton, Steve Reed, Jim Landau, Winslow Hartford, and the proposer, Walter Nissen.

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JAN 4. Your doctor gives you n tablets, which you keep in a bottle. Each day you are supposed to take one-half tablet. Your method for doing so is to shake the bottle until either a full tablet or a half tablet falls out (assume the full and half tablets have the property that the probability one falls out is the proportion of that type in the bottle). If a half tablet falls out you take it. If a full tablet falls out, you break it in two, take one half and put the other half back in the bottle. If you keep track of the days that you break a tablet this will be a sequence of n numbers (always starting with a 1 since you only have full tablets when you start). Concentrate now on the last day you break a tablet. The earliest last day could be n and the last could be $2n - 1$. All other days in between are possible and some occur more frequently than others. The question is: What is the average last day you break a tablet?

The following solution is from Matthew Fountain: The average last day is $2n - D$ where $D = \log_2 n + 0.6$. D also represents the average number of half tablets left after the last tablet is broken. I arrived at this value by first applying the Monte Carlo method. I wrote a short Pascal program, which set $x = n$, $y = 0$, and then performed WHILE $x \geq 1$ DO IF RANDOM $\leq x/(x+y)$ THEN BEGIN $x := x - 1$; $y := y + 1$; END ELSE $y := y - 1$. Here x is the number of whole tablets and y is the number of half tablets in the bottle, and $x/(x+y)$ represents the probability of shaking out a whole tablet. The program ends when x reaches 0 and y is number of half tablets remaining. The average values of y obtained on 200 executions each of the program for various values of n are listed below.

n	10	20	40	80	160	320	640	1280
y	2.89	3.72	4.44	4.96	5.44	6.29	7.00	7.40
Log(y)	2.30	3.00	3.69	4.38	5.08	5.77	6.46	7.16

I was then curious if the following method would confirm these values. Each day on the average x decreases $x/(x+y)$ units while y decreases $[y/(x+y)] - x/(x+y)$ units. This change approximates the differential equation $dy/dx = (x-y)/x$ which has the solution $y = kx - x \log x$. With the condition $y = 0$ at $x = n$, $y = x \log n - x \log x = x \log(n/x)$. Because x is the denominator of one side of the differential equation, the equation loses validity near $x = 0$, x being somewhat of an approximation. But it does show that the above values are reasonable, why D lies close to $\log x$, and how D can be estimated for huge n . For example, for $n = 1280$ and $x = 10$, $y = 10(\log 1280) - 10(\log 10) = 10(\log 128) = 48.5$. I then started my Pascal program with the initial value of 10 whole tablets and 49 half tablets. The average of 200 runs was $y = 6.96$, close to the value of 7.40 obtained previously for $n = 1280$. Incidentally, the solution to the differential equation is $y = \log(n)$ when $x = 1$, so that empirically the solution can be used to obtain approximate D by assuming $x = 1$.

It occurred to me that the average outcome D of a jar depended upon the outcome expected of two jars, one containing one less half pill, one containing one more half pill and one less whole pill. D would be the weighted average of the D 's for the latter two jars, with the weighting dependent upon the proportion of whole pills to half pills in the original jar. It should be possible to start with simple cases and build up to any desired case. The diagram below shows how I obtained D 's for jars containing a total of less than five whole and half pills.

Whole pills in jar	0	1	2	3	4
0	—	1.000	2.000	3.000	4.000
1	1.000	1.500	2.000	2.500	
2	1.500	1.083	2.167		
3	1.833	2.083			
4	2.083				

The cells of this array may be represented by $V[x,y]$. The top row cells $V[0,y]$ contain the possible

final outcomes. Each remaining cell contains the average number of half pills expected to result from a jar with contents defined by x,y . Thus $V[1,1]$ contains 1 whole and 1 half pill. $V[1,1] = 1.5$ because there is an even chance that the next day the jar will be at either $V[1,0]$, and ending up with an average of 1 half pill, or at $V[0,2]$, and ending up with an average of 2 half pills. $V[1,2] = 2.000$ because a jar with 2 half pills and 1 whole pill is twice as likely to move to $V[1,1] = 1.500$ as it is to $V[0,3] = 3.000$. The calculation is $(2*1.500 + 1*3.000)/(2 + 1) = 2.000$.

Then I wrote a computer program that calculated similar arrays by repeated calculations of the relationship $V[x,y] = (xV[x-1,y] + yV[x,y-1])/(x+y)$. To conserve memory, the program stored all the rows in the same one-dimensional array $V[y]$. This meant that as each new row was filled in it overwrote the part of the old row that was no longer required. Values of $V[x,0]$ were printed out when calculated. The program obtained the following results. Note that $|y - \log y - 0.60|$ does not exceed 0.03 in any column.

n	10	20	40	80	160	320	640	1280
y	2.93	3.60	4.28	4.97	5.66	6.35	7.04	7.73
Log(y)	2.30	3.00	3.69	4.38	5.08	5.77	6.46	7.16

Also solved by Winslow Hartford, John Pullen, Mary Lindenberg, and Matthew Fountain.

Better Late Than Never

Y1986. Several corrections and improvements have been found by Alan Foonberg, John Drumheller, Daniel Karlan, Alan Katzenstein, and Al Weiss.

4	6-18/9
9	$1^{86} \times 9$
22	$9+8+6-1$
58	$68-1-9$
62	$61+9-8$
64	$(18/9)^6$
70	$69+1^8$
72	$18+9 \times 6$
78	$96-18$
87	$19+68$

1986 OCT 2. Larry Bell has responded.

OCT 3. Naomi Markovitz has responded.

N/D 1. Steve Strauss has responded.

N/D 2. Greg Spradlin, Larry Bell, and Naomi Markovitz have responded.

N/D 3. John Upton, John Cushnie, Greg Spradlin, and Steve Strauss have responded.

N/D 5. In addition to submitting a solution, John Upton suggests two variations to the towers of Hanoi problem. For both variations we keep the rule that no disk may be placed upon a smaller one. In the first variation, disk 1 (the smallest) may not be placed on 4, 2 cannot go on 5, etc. For the second variation disk 1 may move as normal or by exchanging with a disk on another pile. All other disks may only move by exchange.

1987 JAN SD1. The proposer, Jim Landau, noticed that we omitted the operation exponentiation from the list of permissible operators. This, however, did not cause readers much trouble. More serious was the loss of superscripted superscripts in the phototypesetting process. Specifically 7^{991} was printed as 7^{991} and 10^{1082} was printed as 10^{1082} .

Responses were also received from Daniel Karlan, Greg Spradlin, Jim Rutledge, Al Weiss, John Baxter, John Woolston, Michael Bushnell, Steve Feldman, Steve Strauss, Wayles Browne, and Turner Gilman.

Proposers' Solutions to Speed Problems

SD 1. 9. 99.

SD 2. 2.8284... meters.

BRAZIL'S MAJOR COMPUTER COMPANIES

RANK	COMPANY	PERCENT OF BRAZILIAN GROSS INFORMATICS REVENUES 1984
1	Cobra	13.6
2	SID	12.2
3	Itautec	7.7
4	Prologica	7.5
5	Digirede	6.4
6	Elebra Inf.	5.3
7	Labo	4.4
8	Scopus	3.8
9	Sisco	3.6
10	Racimec	3.2

1983, while the number of competing 4341s produced almost doubled, reaching 600 units. Therefore, CAPRE blocked attempts by IBM and Burroughs to introduce new low-end mainframes that would have further competed with high-end Brazilian minicomputers.

Even this prohibition was insufficient. Brazilian firms argued that to compete with IBM they needed products based on proven technology, tested in international markets, and having a large supply of software. In response, SEI took a pragmatic course and relaxed restrictions in this area. It has allowed six Brazilian firms to produce superminis with technology licensed from abroad.

In the first round of minicomputer licensing in 1977, all major American minicomputer manufacturers had refused to share their technology. This time Digital, Data General, Honeywell Bull (a French firm), and several other non-U.S. companies agreed to do so. Two main reasons underlay the change. First, the importance of the domestic market had increased Brazilian firms' bargaining power. Second, the Brazilian government, in response to complaints from American firms, agreed to consider extending licensing agreements for another five years. It also

agreed that transferred knowledge would be kept confidential for five years from the end of the licensing agreement rather than the beginning.

Thus, when the Brazilian Congress passed the National Informatics Law almost unanimously in October 1984, it simply reaffirmed a policy that had evolved over a decade or more. Professional and scientific associations, industrial associations, all political parties, and a wide variety of public-interest groups supported the law.

The Policy in Action

Both the popularity of the informatics law in Brazil and the concern abroad are due to the success of the market-reserve policy. When CAPRE first restricted imports of data-processing equipment in 1974, the Brazilian computer market was valued at about \$700 million. All equipment was either imported or produced by subsidiaries of foreign firms. Today Brazilian-controlled firms collect 55 percent of total revenues. Between 1975 and 1986, the number of computers produced by Brazilian-controlled firms jumped from 5 percent to over 75 percent. In 1986, more than 270 Brazilian companies accounted for 55 percent of the \$2.7 billion domestic market in superminis, minicomputers, microcomputers, peripherals, and services. Gross revenues in the domestic informatics industry grew at about 75 percent a year between 1979 and 1985. The industry currently employs 16,000 people, one-third of whom hold university degrees.

The largest growth has been in microcomputers. The number of national microcomputer firms has expanded dramatically—from 2 in 1979 to 33 in 1984. These firms have kept up with the latest technology. In 1986 Unitron introduced a copy of Apple's Macintosh. Scopus developed a supermicro capable of running both AT&T's UNIX operating system and the DOS operating system for IBM compatibles. Digirede, Brazil's major independent producer of banking automation systems, developed a computer based on Motorola's 68000 chip and tailored to financial, commercial, and administrative uses. Itautec introduced a microcomputer that is compatible with the IBM PC-AT but that runs faster.

Foreign firms continue to dominate the mainframe field, led by IBM with about 70 percent of the \$881 million market in 1984. But IBM's share of the low-end mainframe/high-end minicomputer market has



been steadily declining, following an international trend. By 1982 Brazilian firms controlled a tenth of the value of the installed base, represented mainly by the Cobra 500 series. The introduction in 1986 of Brazilian superminis based on technology licensed in 1984 will certainly accelerate this trend.

Some Brazilian firms have actually improved mini-computers that were based on previously licensed technology. Edisa used a Motorola chip to transform obsolete technology it had licensed from Fujitsu in 1978 into an efficient banking computer. Edisa's experience with this project allowed it to develop a new multiuser supermicro in 1984. One year later this machine accounted for 33 percent of the firm's revenues.

Computer and related exports have been growing rapidly in recent years—100 percent in 1985—but they still are far below exports by foreign companies operating in Brazil. In 1985, while foreign firms exported equipment valued at \$193 million (mainly mainframes, parts, and peripherals) from Brazil, national firms exported just \$11 million worth. IBM accounted for 80 percent of total computer exports. That company's recent selection of Brazil as the site for an international procurement office should increase its exports sharply, as an increasing number of parts and components for IBM equipment worldwide will be bought in Brazil.

Brazilian-controlled firms export primarily to Latin America. Three Brazilian firms have entered the Argentine market for banking automation after winning contracts in competition with major international companies. Digirede established a joint venture with an Argentine firm, while SID and Itautec are selling their technology. Racimec has also signed contracts totaling \$20 million to export its unique lottery-processing technology to several countries.

The Brazilian informatics industry is investing heavily in R&D, although perhaps less than similar companies abroad. Brazilian firms invested \$69 million in R&D in 1982; only three years later R&D expenses had risen to about \$130 million, or 11 percent of gross revenues. (The U.S. minicomputer industry invests about 12 to 14 percent of its revenues in R&D.) And the incentives recently established by PLANIN should further increase the amount of capital spent on R&D and training.

According to the country's technology-transfer laws, agreements on software imports, either for direct licensing or distribution, must be approved by

the National Institute for Intellectual Property (INPI). Brazilian technology-transfer legislation does not allow restrictions—such as those forbidding R&D on the product licensed—to be imposed on the Brazilian licensee. Foreign firms also cannot restrict Brazilian use after the contract expires or restrict improvements on the original technology during the period of the contract. Moreover, all licensing agreements are limited to five years, royalties paid to foreign licensees cannot exceed 5 percent of net sales. Over 280 Brazilian software companies now compete with 580 foreign firms.

Criticism and Reality

Opponents of Brazil's market-reserve policy—including some Brazilian politicians and industrialists as well as critics abroad—argue that the policy holds back development by artificially shielding domestic firms from international competition. They say the policy is leading Brazil's computer industry down a path of technological backwardness, and that domestic consumers must pay higher prices for inferior equipment. Yet the evidence shows that almost all these criticisms of Brazil's policy are weak. Moreover, Brazil is responding flexibly to those that are valid.

When in 1977 Cobra tried unsuccessfully to license minicomputer technology from Data General and Digital, the head of Data General's service office argued that Brazil's policy, if successful, would be a dangerous international precedent. Data General wanted Brazil to reduce import tariffs on minicomputers and remove limits on royalty payments and the length of licensing contracts. At that time the U.S. trade representative took no action.

Six years later, Data General again asked the U.S. government to negotiate a change in Brazil's technology-transfer laws. The company wanted the United States to pressure the International Monetary Fund, the World Bank, and other trade and aid programs to force concessions from developing countries, including Brazil. Data General called for bilateral talks between the United States and Brazil. It suggested that the General Agreement on Trade and Tariffs (GATT), the forum for international trade negotiations, was too cumbersome to deal properly with the issue.

As the representative of American industry, the U.S. Department of Commerce has criticized a sup-



*In 1982
Brazilian clones
of the Apple II
were 2.2 times
more expensive
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By 1984 they
were 8 percent
cheaper.*

posed inconsistency between policy and practice. Although the 1984 law prohibits joint ventures between Brazilian and foreign firms in some areas, Brazilian firms continue to encourage such partnerships, perhaps hedging their bets should the law change.

The Commerce Department also argues that the informatics policy hurts Brazilian consumers, because Brazilian firms do not supply state-of-the-art technology at competitive prices. Finally, the department claims that foreign software firms are discouraged from entering the Brazilian market because neither patent nor copyright protection is available. That Brazil did not allow software to be copyrighted was, until recently, a particularly sore point.

However, market-reserve policies are not unique to Brazil. Many nations use them to reduce their dependence on imports and ease their balance of payments. The United States adopted such policies in the nineteenth century to protect its textile-machinery industry from British competition. Japan has used them for 30 years to promote its consumer electronics, semiconductor, and other industries.

NASA and the Defense Department restricted purchases of electronic components and equipment to U.S. firms in the sixties. The Defense Department is currently under pressure to avoid buying foreign equipment and technology on the grounds such purchases hurt national security. A recent U.S.-Japan trade agreement that requires Japan to sell microchips at fair market value, and National Security Council proposals to shield the U.S. microelectronics industry from Japanese competition, are similar protectionist moves.

Moreover, both Brazil and the United States are signatories of the General Agreement on Trade and Tariffs (GATT). According to this set of regulations, developing countries have the right to restrict imports in certain industries. GATT also recognizes these countries' right to subsidize infant industries.

Brazil's National Informatics Law does not even prohibit direct foreign investment, provided Brazilians retain 70 percent voting and managerial control. IBM recently took advantage of this opportunity by investing \$20 million in a joint venture with the Brazilian group Gerdaul to sell data-processing and

Brazil's
computer
policy may
have cost U.S.
manufacturers
\$1.5 billion in
sales between
1980 and 1984.



software services. (Brazilian firms fear that such arrangements may be the computer giant's attempt to gain a toehold for the day the market-reserve policy ends.)

The National Informatics Plan even *specifies* a large role for foreign firms, and U.S. computer firms do a good business in Brazil. They have licensed technology to Brazilian firms for mainframes, superminis, minicomputers, peripherals, modems, computer-aided design, computer-aided manufacturing, computerized numerical control, programmable logic control, chromatography, and micro-development systems. Furthermore, almost 200 U.S. firms export parts, modules, and components to Brazil. Between 1979 and 1985 the adjusted gross sales of U.S. computer companies in Brazil increased from \$533 million to almost \$1 billion. Moreover, between 1974 and 1983, foreign computer firms (of which U.S. companies are a clear majority) sent profits home of almost twice the value of their total direct investments.

Criticism of Brazil's lack of copyright protection for software is also misplaced. On the one hand,

copyright law has never assured software confidentiality, not even in the United States, where illegal copying is common. More important, at least since June 1984, when it sponsored an international conference on software copyright laws, the Brazilian government has been making an effort to protect foreign software manufacturers. Finally, in October 1986, Brazil responded to criticisms and adopted international copyright law for software protection.

The objection that the market-reserve policy means higher prices for end-users is similarly questionable. In July 1982 an Apple II clone manufactured in Brazil was 2.2 times more expensive than the original, but less than two years later Brazilian-made equipment was 8 percent cheaper than its U.S. counterpart. Brazilian clones of the TRS-80 showed the same pattern, and the current wave of IBM-PC and AT clones is expected to follow suit.

By contrast, the price of the central processing unit of a Hewlett-Packard HP-85 scientific microcomputer manufactured in Brazil is 1.36 times that of the one produced in the United States. If the cost of peripherals is added, the Hewlett-Packard system be-



comes 50 percent more expensive than that of its U.S. equivalent. Between 1981 and 1983 the prices of Brazilian-produced minicomputers varied only 5 percent from equivalents sold in the United States.

Also weak is the argument that adopting old technology hurts the international competitiveness of Brazilian industry in general. The latest computer technology is not necessary for achieving international competitiveness. Manufacturing firms in central and northwestern Italy have successfully used modern technology, though not necessarily the most modern, to carve out niches in textiles, clothing, specialty chemicals, industrial instrumentation, and specialty steel—while increasing exports and local jobs. Conversely, U.S. manufacturing has lost its competitiveness despite easy access to the most advanced computer technology.

Attempts to export the Brazilian model to other newly industrializing countries (NICs) would be problematic at best. The major Asian NICs—South Korea, India, Taiwan—already have computer policies that reflect their own development strategies and international alliances. All three are committed to exports, in contrast to Brazil's internal-market orientation. Countries such as Mexico and Argentina would face a host of unique problems in implementing a computer policy patterned after Brazil's, including a lack of economic and human resources, a weaker established role in the international economy, and relatively small domestic markets. Argentina's previous military government left a large foreign debt (although smaller than Brazil's) and a rather weak and de-industrialized economy. And Mexico's vast common border with the United States would nullify any attempts to isolate a domestic market. Over two-thirds of the microcomputers currently in use in Mexico have been smuggled across the border.

Future Challenges

Not the least of Brazil's future problems stems from the United States. In September 1985, under pressure from Congress to halt the growing U.S. trade deficit, the Reagan administration began to investigate Brazil's informatics policy. The American Electronics Association (AEA) asked the U.S. government to request Brazil to lift its market-reserve policy and end some restrictions on imports of high-tech products. The AEA has also asked for changes in Brazil's intellectual

property laws. And the U.S. Computer and Business Equipment Manufacturers Association, which has issued perhaps the most comprehensive critique of Brazil's informatics policies, has repeated Data General's earlier call for quick bilateral negotiations.

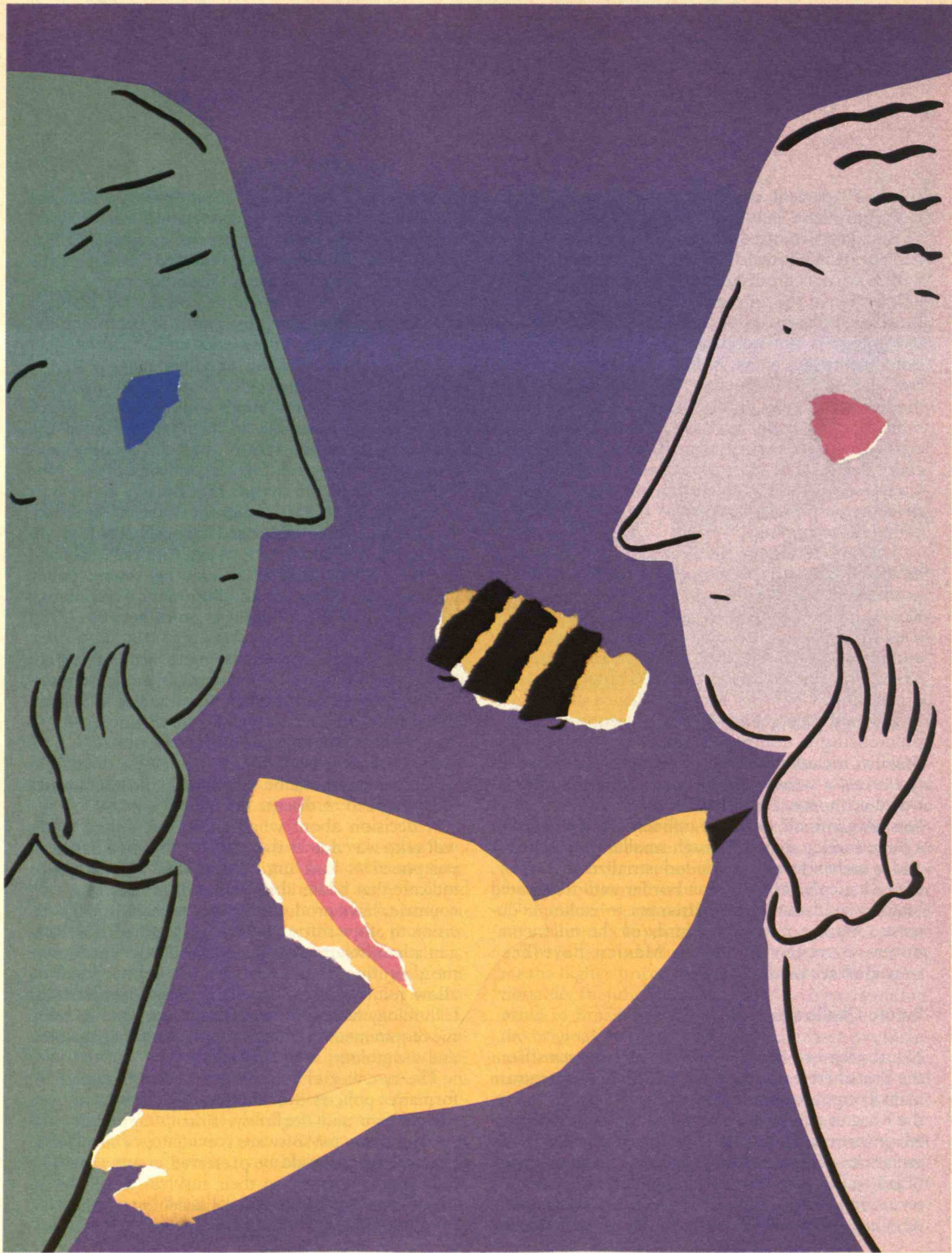
The American investigation, conducted through the U.S. trade representative, aims to determine the extent to which the informatics policy restricts foreign participation in the Brazilian market. If the trade representative decides that Brazil's practices are unfair, the United States could retaliate. Brazil is especially vulnerable to such action since the United States buys a fourth of all the country's exports, especially steel, textiles, and shoes.

As a result of the charges that Brazil's policy hurt U.S. interests, in early 1986 the White House Economic Policy Council formed a working trade group to suggest retaliatory actions against Brazil. Council members argued that Brazil's market-reserve policy had cost U.S. computer and information-technology manufacturers \$1.5 billion in sales between 1980 and 1984.

As the United States has made clear in current GATT negotiations, removing restrictions on international high-tech trade remains a major U.S. goal. Brazil and India have fought at least since 1982 to keep high-technology protectionism out of GATT talks. Under intense U.S. pressure and the threat that GATT talks would be suspended, those countries finally agreed to discuss the issue.

A decision about what action the United States will take was due at the end of 1986, but has been postponed at least until July 1987. This seems to indicate that bilateral negotiations between the two countries have produced results, such as Brazil's decision to allow software to be copyrighted. The Reagan administration has lately asked Brazil to change the definition of national firm. It wants Brazil to allow joint ventures in which foreign suppliers of technology have a 50 percent interest, and to relax the requirement that Brazilians control management and technology.

The two key characteristics of the Brazilian informatics policies over the past 15 years have been pragmatism and flexibility. Brazil's approval of a copyright law for software is evidence of this. These characteristics should be preserved at any cost. The only serious menace to their survival would be an unnecessary and unjustified hardening of the U.S. position. □



Letter, marked copy, and 10
extra copies to author.

The Crisis in Contraception

BY ELIZABETH B. CONNELL

THE United States has led the world in contraceptive research and development for many years. Americans have provided most of the basic scientific data, expertise, and manufacturing capability for contraceptive technologies now in use around the world. However, the United States is losing its leadership role in this area—with potentially disastrous consequences for women and men in this country and elsewhere.

The increasingly litigious climate in this country is one major reason for our technological slippage in this field. The growing number of lawsuits against companies that manufacture contraceptives has prompted many to withdraw products such as intrauterine devices (IUDs) from the marketplace. As a result, there are fewer contraceptive options available to Americans than there were a decade ago.

Fear of litigation has also discouraged companies from introducing safer and more convenient contraceptives to the domestic market, although they continue to test and sell new products abroad. It is particularly ironic that a number of excellent products developed by Americans, such as Depo-Provera (an injectible contraceptive) and the copper-bearing IUDs, are now available virtually everywhere in the world *except* the United States.

This situation has been aggravated by widespread public misunderstanding about the risks and benefits of certain birth-control methods. This is particularly true of the pill, whose risks have been grossly exaggerated in proportion to its benefits.

A steady decline in federal funding for contraceptive R&D in recent years has further exacerbated the situation. In 1985, for instance, the National Institutes of Health (NIH) allocated only \$7.5 million for contraceptive research, down from \$38 million spent by the U.S. government in 1974. The Reagan administration has sliced contraceptive funding for both research and services because of political pressure from religious groups and right-wing organizations.

For all of these reasons, the United States is facing a crisis in the development and use of contraceptives. While everyone is affected, two groups are suffering the most. The first is our teenage population. The United States now holds the dubious distinction of having the highest rate of teenage pregnancies anywhere in the developed world. Our rate is seven times higher than that of the Netherlands, and more than twice as high as that of Canada, Denmark, England, Finland, New Zealand, and Sweden, even though our teenagers are not more sexually active. More than 1 million U.S. teenagers become pregnant each year, with almost half of the pregnancies ending in abortion. If current trends continue, 40 percent of today's 14-year-old girls will be pregnant at least once before age 20.

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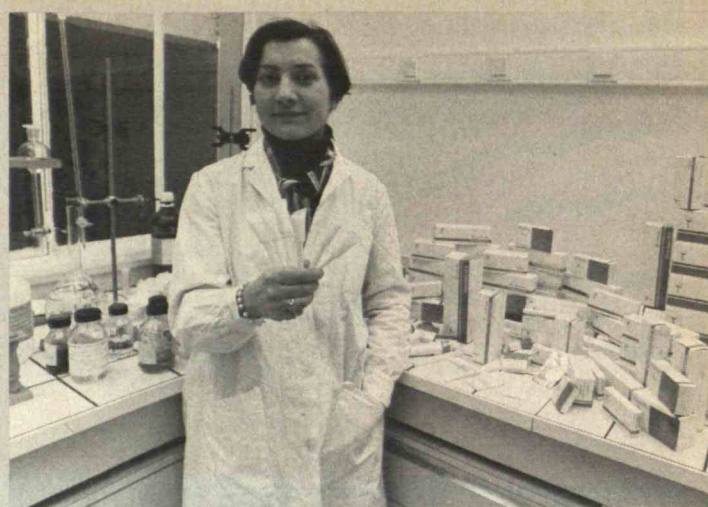
*Political pressures
and litigation are driving contraceptives
off the market and stifling research
and development in this area.*

The vast majority of teenagers don't give their babies up for adoption, and they face all the medical and socioeconomic problems that occur when children have children. The Center for Population Options in New York estimates that the cost to the public of teenage childbearing was \$16.65 billion in 1986. This figure does not include the costs of housing, day care, special education, and numerous other needs, all of which are steadily increasing as more and more teenagers keep their babies.

While inadequate sex education programs and the lack of easily available contraceptive services play a role in this epidemic, many pregnant teenagers say they failed to use birth control because either they didn't know there were safe and effective methods or they didn't know how to obtain them. Educating teenagers about contraceptives becomes even more of an urgent priority with the looming threat of AIDS and other sexually transmitted diseases.

A different problem exists at the other end of the age spectrum. Women who are beyond the age when the pill is deemed appropriate—35 to 40—still face 10 to 15 years of potential fertility. Yet the options available to these women are narrowing. As a result, many of them (or their husbands) will undoubtedly resort to possibly irreversible sterilization procedures for which they are not psychologically ready. Furthermore, while a vasectomy has some risks of minor side effects, a tubal ligation—a surgical procedure often done under general anesthesia—carries a small but real risk of significant complications.

The current crisis is also creating problems for other countries. Since many developing nations do not have a regulatory agency such as the Food and Drug Administration (FDA), they have traditionally looked to the United States for guidance in evaluating new drugs and devices. So when birth-control methods are discontinued here for economic reasons, or are not approved by the FDA for political reasons, other countries often get the impression that they are unsafe or ineffective. Thus, the decline in contraceptive development and use in the United States is resulting in fewer contraceptive options for those countries. To make matters worse, the current administration has refused to fund any international family-planning organizations that offer abortion counseling or referrals along with other forms of birth control. This could have particularly serious repercussions for nations with uncontrolled population growth.

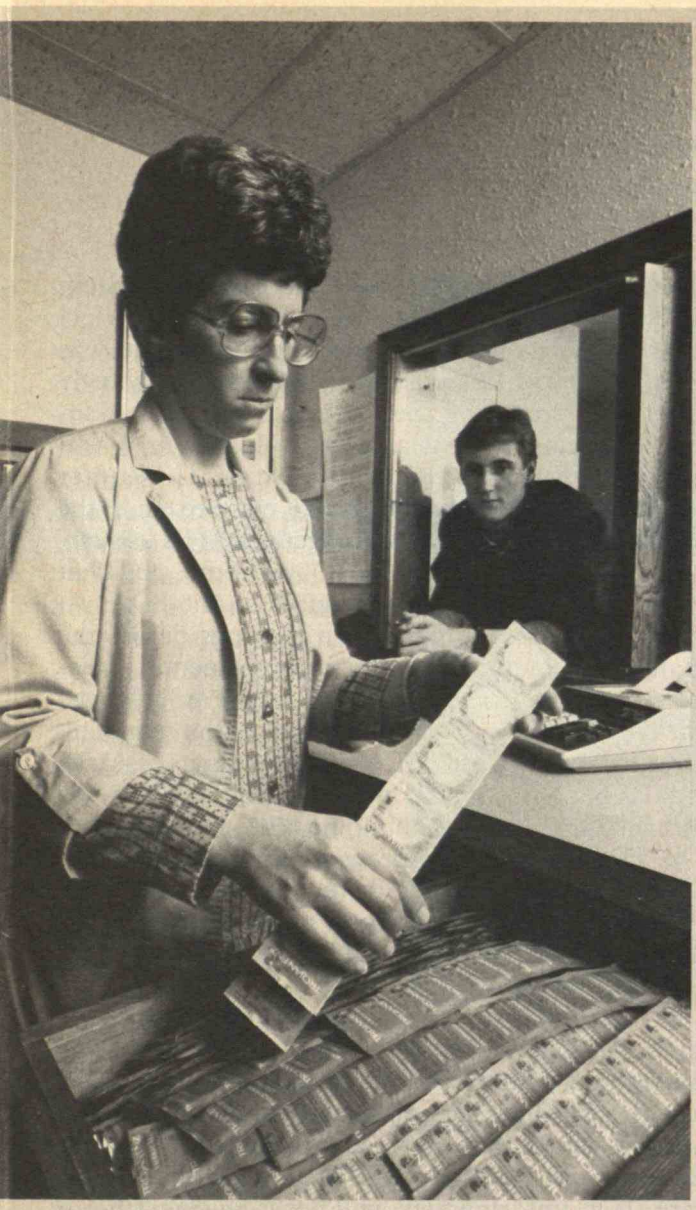


A researcher at Ortho Pharmaceutical examines cell cultures through a microscope (left). The fear of litigation is so strong that Ortho is the only U.S. company still spending significant sums on contraceptive R&D. In addition, several birth-control devices have been withdrawn from the domestic market. But because of AIDS, firms that make condoms are doing better than ever (right). Meanwhile, foreign scientists continue to work on new contraceptives. The Pharmalec Corp. in France has developed a spermicide found to be effective against the AIDS virus. A lab technician (above) displays the product.

Sneezing to Prevent Pregnancy

Ever since our ancestors concluded that there was a causal relationship between sexual intercourse and the birth of a baby, both men and women have searched for ways to control their fertility. Some of these techniques seem ludicrous in light of today's knowledge, while others were scientifically quite perceptive. Some were extremely dangerous and even lethal.

Every country had its own superstitions. In Rome around the sixth century B.C., women wore the testicles of a cat in a tube around their waist. Women in other regions believed that sneezing and jumping after intercourse would prevent conception, and still others claimed success from burning moxa-balls (small packets of medicinal herbs) on the abdomen. Barrier devices that prevented sperm from entering the cervical canal were made of numerous plant and



animal materials such as cabbages, pomegranates, leaves, animals' ear wax, and elephant dung. The ingestion of heavy metals for contraception killed many women during the Middle Ages, and many women died as a result of mutilating sterilization procedures.

Condoms, in one form or another, have been employed ever since prehistoric times, but the use of modern condoms began with the industrialization of rubber. A modern version of the diaphragm was developed in the late nineteenth century, and spermicides, made from chemicals toxic to sperm, were introduced for contraceptive use around the 1930s and 1940s.

Before the development of the pill and IUDs, barrier contraceptives were the only reliable methods of birth control. But they have to be used with every act of intercourse, and many users find them inconvenient and aesthetically unattractive. Furthermore,

these devices are not completely effective in preventing pregnancy—condoms occasionally tear and diaphragms fitted or used improperly do not always prevent sperm from getting into the cervical canal. For these reasons, barrier methods were rapidly replaced by oral contraceptives and IUDs when they became available.

The FDA approved the first oral contraceptive in 1960. The pill contains two female hormones: estrogen, which blocks ovulation, and progestin, which promotes cyclic bleeding. The pill seemed safe and effective during initial clinical tests. However, data accumulated during the mid- and late 1960s, when the pill became more widely used, indicated that there were risks for certain individuals. For instance, use of the early oral contraceptives resulted in a seven fold increase—to 3 in 100,000—in women's annual death rate from thromboembolism, a blood-clotting disease. Pill use also caused a fourfold increase in users' risk of stroke, and a threefold increase in their risk of heart attacks.

However, the risks of heart attacks and strokes appeared only in 35-year-old women who smoked and 40-year-old women who did not: there have been no reported deaths from the pill owing to these cardiovascular diseases in women under the age of 25. Long-term risks apply only to women who have additional risk factors such as age and smoking. Thus, for women without these risk factors, it is far safer to take the pill than to carry a pregnancy to term.

Making a Safer Pill

After these initial risks came to light, researchers modified the pill, lowering the dosage first of estrogen and then of progestin. The amount of estrogen, for instance, declined from more than 100 micrograms to 30 micrograms. As a result, the incidence of serious side effects is considerably lower in the pills sold today. And as the newer, low-dosage pills become more widely used, we can look forward to even fewer long-term cardiovascular side effects. Yet the almost 100 percent effectiveness rate of the early oral contraceptives, when taken properly, has been maintained.

Despite this track record, the use of oral contraceptives has declined. This is largely because the pill's early risks received a disproportionate share of public attention. The first major assault against the pill

*The pill's early risks
received a disproportionate share
of public attention.*

took place during U.S. Senate hearings held by Sen. Gaylord Nelson's Subcommittee on Monopoly of the Select Committee on Small Business in 1970. In the opening days of these hearings, witnesses antagonistic toward oral contraceptives such as Hugh Davis, inventor of the Dalkon Shield, testified about their risks. This early testimony received extensive media coverage. Only later in the hearings did witnesses such as myself and Alan Guttmacher, president of Planned Parenthood, present a more balanced view of the pill's risks and benefits. But by then the damage had been done.

The legacy of these hearings and later reports about adverse side effects was vividly documented in a 1985 Gallup poll commissioned by the American College of Obstetricians and Gynecologists. The poll showed that the public's fears far exceed the real dangers of oral contraceptives. For example, about 75 percent of the men and women interviewed thought that the pill posed a serious threat to health. Of these, one-third believed that women taking these agents are at risk of developing cancer.

This viewpoint is particularly disturbing because, according to recent studies, the opposite is true. The pill not only does not cause malignancies but actually protects against cancer of the endometrium, the tissue lining the uterine cavity, and the ovary, the latter disease being almost always fatal. Howard Ory, of the Centers for Disease Control (CDC), has estimated that 1,700 hospitalizations for ovarian cancer and 2,000 for endometrial cancer are prevented each year by the use of oral contraceptives. In addition, 23,490 admissions for benign breast disease are averted annually, according to CDC estimates. Studies have shown that the pill continues to offer this protection for at least 10 to 15 years after women stop taking it.

Clinical studies have revealed other health benefits from the use of oral contraceptives. It is now well established that these potent hormonal agents protect against a number of medical conditions including ectopic pregnancy, a potentially fatal condition in which the fetus develops outside the womb in one of the woman's two fallopian tubes. The pill also protects against numerous conditions, including ovarian cysts, fibroid tumors of the uterus, pelvic inflammatory disease, excessive menstrual bleeding, and weakening of the bones (osteoporosis). Yet under intense pressure from some consumer groups, the FDA has not allowed information about these

significant health benefits to be included in the packaging for oral contraceptives.

Similarly, the vaginal contraceptive sponge was attacked by two activist consumer groups shortly after its approval by the FDA in 1983. The Associated Pharmacologists and Toxicologists in Washington, D.C., and the Empire State Consumer Association in Rochester, N.Y., claimed that the sponge contained three carcinogens, that its use carried a high risk of toxic shock syndrome, and that it had been inadequately evaluated by the FDA.

These charges culminated in hearings before the House Subcommittee on Intergovernmental Relations and Human Resources in July 1983. All the allegations were essentially refuted by the manufacturer of the sponge, VLI Corp., based on its research data. The NIH, which provided funding for the sponge's development, found no reason for concern. The FDA did not withdraw its approval nor recommend any alterations in the product's labeling. The media, however, focused primarily on the alleged risks of the device and the public once again became alarmed.

In my opinion, the concern about contraceptives—and indeed all new medications—can be traced to a general belief that all drugs and devices should be totally safe and effective. Given the great scientific advances made in recent years, many people believe there should be no risks associated with medical care. This, unfortunately, will never be true, since it is impossible to develop any agent powerful enough to produce a desired biologic effect that will not have an adverse effect on a few susceptible people. Therefore, every treatment has and will always have its own risk-benefit ratio for any given individual.

The Disappearance of the IUD

The first intrauterine device was invented in the early 1920s. Several centuries before, camel drivers somehow learned that placing pebbles in the uteri of their female camels would keep them from getting pregnant while crossing the Sahara. Foreign bodies inserted into the uterine cavities of women were later shown to induce biochemical changes that were either toxic to sperm or did not allow the implantation of a fertilized ovum.

Like the pill, the early IUDs seemed to be highly effective and safe. However, studies with larger numbers of users soon revealed adverse effects, partic-

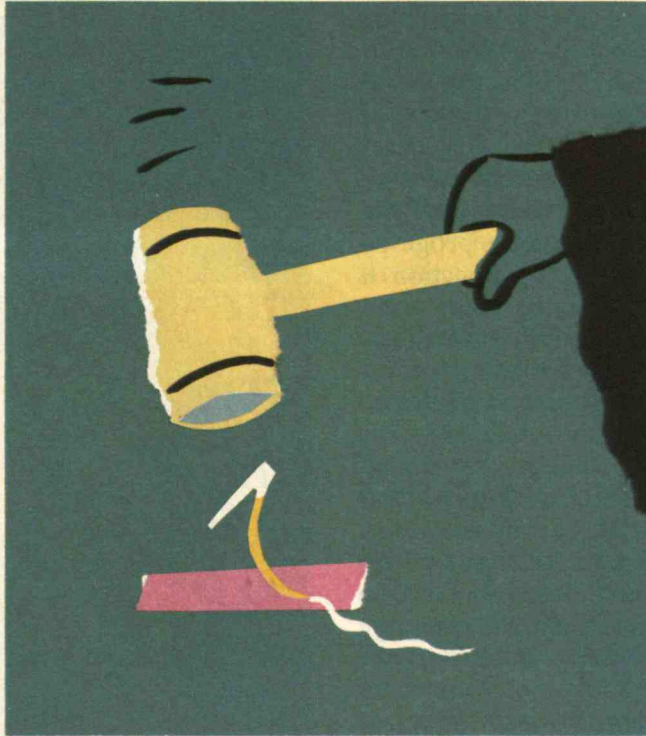
*IUDs are no longer available
in the U.S. because companies
cannot obtain liability coverage.*

ularly in the case of the Dalkon Shield. This plastic device was found to be very dangerous because its tail, composed of hundreds of small filaments encased in a sheath, acted as a wick, allowing bacteria from the vagina to ascend into the uterus. Hundreds of cases of pelvic infections resulted from the use of the Dalkon Shield, causing sterility and a number of deaths among women using this IUD.

At least 12,000 lawsuits and more than 325,000 claims were filed against A.H. Robins, the manufacturer of the Dalkon Shield, forcing it to withdraw the IUD and later file for bankruptcy. In this particular case, there seems to be clear evidence of corporate irresponsibility. According to internal memos released during litigation, Robins officials had known of the dangerous wicking tendency of its IUD before they marketed the device.

All the other marketed IUDs had monofilament (single filament) tails, which do not have as much potential for infection. There are two major types of IUDs: the earlier, non-medicated devices made of plastic such as Saf-T-Coil and Lippes Loop, and the more recent medicated devices made out of plastic to which copper (Copper-7 and Tatum-T) or a progesterone (Progestasert) have been added to increase their effectiveness. The medicated devices are smaller and better tolerated, producing fewer cases of cramping and bleeding than their predecessors. Furthermore, two studies published in the *New England Journal of Medicine* in 1985 showed little or no increased risk of tubal infertility from the use of copper IUDs in monogamous couples. The Saf-T-Coil and Lippes Loop have since been removed from the market for economic reasons.

However, fears aroused by the Dalkon Shield fiasco have prompted a number of lawsuits against the widely used Copper-7. The suits claim a variety



of injuries, primarily related to pelvic infections. Most of these suits have been decided in favor of the manufacturer, G.D. Searle.

Despite these favorable judgments, Searle decided in January 1986 that it was no longer economically feasible to continue producing the Copper-7 and the Tatum-T. While sales of the Copper-7 amounted to \$11 million in 1985, the successful defense of just four of the Copper-7 lawsuits cost the company \$1.5 million. With more than 300 lawsuits pending, Searle found product-liability insurance for both products to be vir-

tually unobtainable.

One decision in a 1986 lawsuit against Searle may discourage some future IUD litigation. U.S. District Court Judge Joseph H. Young in Baltimore declared that the evidence submitted on behalf of 17 Copper-7 users who had sued Searle was nothing but a "series of alternative unsubstantiated theories." He concluded that the "plaintiffs had failed to present sufficient evidence of causation" and rendered a verdict in favor of Searle.

Unfortunately, that court decision will probably not change the decision of Searle and other pharmaceutical companies to stay out of the IUD market. As a result, the newest IUD—the Copper T Cu 380A—may never be brought to the U.S. market. Yet this IUD is the best of the copper devices (it has the highest rate of effectiveness) and has already been approved by the FDA.

At present, at least 2.3 million American women use an IUD. When those devices need to be replaced, most of these women will have to find some other form of contraception. Jacqueline Forrest of the Alan Guttmacher Institute, a New York-based research organization, has statistically estimated that 160,000 unintended pregnancies will occur from the discontinuation of IUD production in the United

States, resulting in 72,000 live births and 88,000 abortions.

The Controversy over Depo-Provera

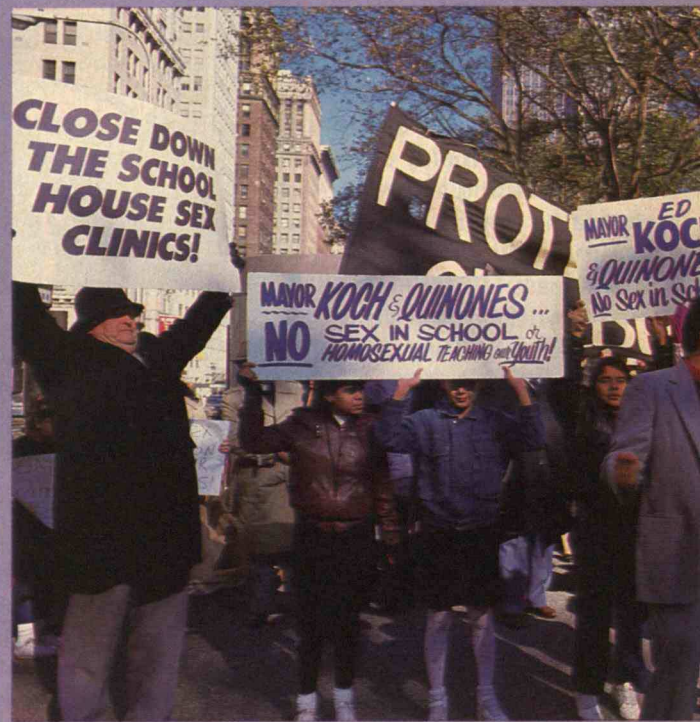
Another unfortunate victim of the current medical-legal climate is Depo-Provera (depo-medroxy progesterone acetate), a long-acting injectable progestin that acts by blocking ovulation. The injection is given by a health-care provider once every three months. This route of administration not only allows for long-term effectiveness but is particularly desirable in many areas of the world where medications are perceived to be of value only when given by injection. Depo-Provera has been shown to be extremely safe and virtually 100 percent effective. This agent has been used by more than 11 million women in over 80 countries for more than 20 years with no reported deaths. Yet it has never been approved in the United States because of political reasons.

The FDA's scientific advisory committees, the World Health Organization, and numerous other national and international groups have reviewed the data on Depo-Provera and recommended its use as a contraceptive agent. However, the drug has been the target of various consumer and feminist groups such as the National Women's Health Network, *Mother Jones* magazine, and the Institute for Food and Development Policy.

These opponents have cited animal data on malignancy that are probably irrelevant to women. For instance, beagles given high doses of Depo-Provera developed breast tumors. However, the beagle has a high spontaneous rate of breast lesions, and British scientists have recently stated that it is not an appropriate animal for testing hormonal agents. Two of fifteen rhesus monkeys receiving 50 times the contraceptive dose developed endometrial cancer, but in a tissue not found in the human female. Moreover, this tumor has also been reported to occur in untreated animals. While critics maintain that Depo-Provera can cause birth defects, there is no evidence that this has occurred. Furthermore, this agent is so effective as a birth-control method that the risk of exposing a fetus to the drug is extremely low.

Opponents have also claimed that Depo-Provera causes permanent sterility, but studies have shown normal pregnancy rates approximately one year after stopping the medication. Most women do experience irregular menstrual cycles, and sometimes

Although American teenagers are not any more sexually active than their counterparts elsewhere in the world, they have the highest rate of pregnancies. Public schools are trying to remedy the situation by teaching students about reproduction and contraception (near right). Protests have hampered such efforts (below), but Planned Parenthood has helped out with ads that promote birth control (far right).



a complete absence of menses, while using this contraceptive. But this has not been shown to have adverse effects on their health or future fertility.

Despite the agent's long-term record of safety, an FDA Public Board of Inquiry recommended in 1985 that Depo-Provera not be approved without more research to establish its long-term safety. The Upjohn Co. is currently preparing a new application to the FDA based on recent international studies that document Depo-Provera's safety and efficacy.

Other contraceptive agents currently under attack are spermicides, which work by chemically disrupting the membrane covering the head of the sperm. These are manufactured as jellies, creams, and foams and are used either alone or with a diaphragm, condom, or in the vaginal sponge. In 1985, in a non-jury trial in Atlanta, a judge awarded \$5.1 million



contraceptives will become available in the near future. It is very difficult and sometimes impossible to obtain funds to pursue promising leads for new contraceptive technologies. Two factors are to blame. First, as I mentioned, federal funding of basic research—in both government and university labs—has steadily declined over the last six years. Second, the development of a new product is very expensive (it costs approximately \$50 million) and very time consuming (it takes about 15 years to bring an idea to market). Unless companies expect a product to produce a reasonably good financial return, they are unwilling to make a major investment.

Even if U.S. companies decide to develop and test new contraceptives, they may not be able to obtain liability insurance for them. And there is always the fear of litigation, which can occur regardless of the product's safety record in clinical tests.

For these reasons, the number of pharmaceutical companies working in the field of contraception has dropped precipitously over the last decade. The Ortho Pharmaceutical Corp. is the only major U.S. company now committing significant amounts of money to developing contraceptives.

A classic example of this dilemma is a biodegradable contraceptive capsule known as Capronor, developed with NIH funding. This agent is implanted under the skin of the arm and releases a progestin, which also blocks ovulation, for a year. The product has been ready for clinical testing for more than two years, but no company has been able to obtain product-liability insurance in order to supply clinical researchers with the implant.

The same situation will probably apply to IUDs. A new tailless magnetic IUD has been developed by researchers at Emory University and the Georgia Institute of Technology. The magnet is used to detect and remove the IUD, so the tail—which can allow bacteria to pass into the uterine cavity—is no longer necessary. This new device is also almost ready for clinical trials. Yet it is unlikely that this or any other promising new IUD will undergo clinical trials in the United States, at least in the foreseeable future.

The current political climate is also inhibiting the availability of completely new technologies. This is particularly true in the case of RU 486, a steroid compound developed by the Roussel-Uclaf Co. of France and soon to be marketed there. RU 486 acts by suppressing the corpus luteum—a structure that develops in the ovary following ovulation and pro-

to a woman who claimed that her child's congenital defects resulted from the use of Ortho Gynol, a spermicide made by the Ortho Pharmaceutical Corp. In his decision, the judge cited a study published in 1981 that purportedly showed a link between congenital anomalies and spermicides. However, this study has many methodological flaws and lacks statistical validity. Moreover, the judge made this award even though most of the evidence presented at the trial showed that there is no proven association between the use of spermicides and fetal damage.

Spermicides are low-profit items, and one or two more suits of this magnitude might be enough to convince U.S. companies to discontinue production. Thus, we face the potential loss of these valuable contraceptive agents as well.

In the meantime, there is little chance that new

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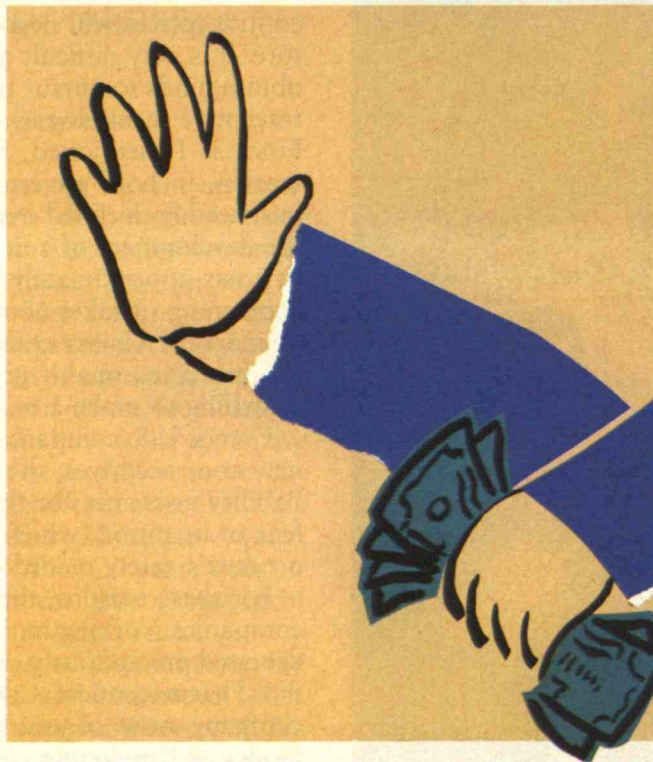
duces progesterone, a hormone essential to the development of a fertilized ovum.

Taken as an oral tablet, this agent interrupts the normal menstrual cycle and can prevent the implantation of a fertilized ovum. It can also be used to terminate pregnancy. Early data from clinical trials in other countries suggest that terminations induced by this agent carry lower complication rates than those linked with the few abortions performed late in the first trimester and in the second trimester.

However, RU 486 is highly controversial because it places control of pregnancy in the hands of women themselves. It thus circumvents any legislative authority and renders the whole abortion debate moot. Needless to say, anti-abortion groups are vehemently opposed to introducing this agent in the United States. Given the current administration's anti-abortion stance, it is highly unlikely that such an agent will be studied and approved in the near future.

Another contraceptive that may not make it to the American marketplace is the Cavity Rim cervical cap, used with a spermicide. Studies conducted with approximately 2,000 American women showed pregnancy rates with this device comparable to other barrier methods. And there are no adverse health effects. Some women prefer the cap to the diaphragm because it is smaller and therefore less apt to affect the vaginal walls. And unlike the diaphragm, it does not put pressure on the urethra and bladder, which can cause urinary tract infections.

However, the FDA classified the cap as experimental in 1981. Therefore, anyone who wished to manufacture this device must accumulate all the data from the various centers where the cap was tested and submit the information to the FDA. This is a time-consuming and expensive exercise. Since the cap—like other barrier methods—would probably



not be a major income producer, and ensurers would assign manufacturers the same liability as that for the sponge and other vaginal contraceptives, it is unlikely that any U.S. company will pursue FDA approval.

Other contraceptives such as an implant encased in biocompatible plastic, a steroid-containing vaginal ring, and an antipregnancy vaccine have been investigated for more than a decade. But for the same reasons, these products are not likely to reach the American marketplace.

A Male Contraceptive?

Activist women's groups have often charged that there are no male contraceptives available today because most of the researchers are men who only want to work on methods for use by women. In reality, much time and money has been spent trying to develop safe and effective birth control for men.

It is much more difficult to control male fertility. A woman produces only one egg per month and is fertile for only about 12 hours. A man, however, produces as many as 30 million sperm per day and is almost constantly fertile. Preventing the development of a single egg is less difficult than reducing the sperm count to zero for long periods of time.

The World Health Organization has predicted that it will be more than 20 years before a male contraceptive becomes available for general use. Even if one is marketed, it would not eliminate the need for good female methods. Many women may not want to entrust their sexual partners with the sole responsibility for preventing pregnancy.

As the contraceptive crisis worsens, American women are being forced to leave the country to obtain contraceptives. This is already happening with the IUD. The Copper T Cu 380A is now available in Canada, the United Kingdom, and continental Europe, and American women are traveling to these

*The media should cover
contraceptive technology in a more balanced
and responsible way.*

countries to obtain the device. While this solution may not pose an inordinate problem for middle- or high-income women, it does for poorer women. This de facto discrimination cannot fail to have serious social and economic repercussions.

The current crisis is also hurting family-planning activities worldwide. When devices such as the copper IUD are discontinued in the United States for purely economic reasons, other countries believe that they are not safe or effective. Similarly, because of the consistent failure of the FDA to approve Depo-Provera, grave doubts about its safety have begun to affect its use in various parts of the world.

To make matters worse, the U.S. government has drastically reduced funding for international family planning in recent years. In December 1984, the Reagan Administration abruptly terminated 17 years of support for the International Planned Parenthood Federation (IPPF) because it would not renounce its members' rights to carry on abortion-related activities with their own funds. The following year the U.S. Agency for International Development (AID) cut \$10 million from support for the United Nations fund for population activities because of its program with China. AID claimed that China coerced women into obtaining abortions, sterilizations, and IUD insertions so the country could attain its population goals. Since the United States has been a primary source of support for such programs for many years, these cuts are hurting many countries' efforts to curb population growth. It is impossible to talk with international colleagues without becoming acutely aware of the immense negative impact we are having on contraceptive programs abroad.

Improving Public Understanding

The track record of the present administration suggests that very little will be done in the next two years to alleviate the contraceptive dilemma. One hopes that the next administration will better understand the need to support the development and use of safe and effective contraceptives. With that in mind, several potential solutions can be explored.

First, efforts must be undertaken by government agencies and the health-care profession to improve the public's understanding of the risks and benefits of available contraceptives. For instance, public education programs, using every type of media to reach the widest audience, should be launched to inform

consumers that today's oral contraceptives are extremely safe and effective. Such programs should also spread the news that copper IUDs are safe and effective for monogamous individuals, who have a lower potential for contracting infections, and that no data exist linking spermicides to fetal defects.

People must also be informed that the condom offers our best defense against the spread of AIDS and other sexually transmitted diseases. U.S. Surgeon General C. Everett Koop has taken an admirable stance in advocating extensive public education programs about AIDS and the use of condoms.

The media should also attempt to cover contraceptives in a more balanced and responsible way. Television is perhaps most in need of improvement. Television executives who broadcast programs and ads that sell sex to teenagers should recognize how hypocritical they are in refusing to run public-service announcements about contraception.

Second, ways must be found to curb the increasing number of lawsuits that claim an association between a product and some sort of damage even though there is no scientific evidence for such a link. The public must be made aware that insurance companies do not have unlimited funds in their "deep pockets," and the public ultimately pays the price for unwarranted judgments.

Some so-called experts testify against drugs and devices without any scientific evidence to back up their claims. Many of these "hired guns" would not be allowed to testify if the courts imposed stricter criteria on expert witnesses' training and experience.

One approach to the product-liability quagmire would be to indemnify manufacturers of high-risk medical therapies against certain types of risk. This has already been suggested for manufacturers of vaccines and might also work for developers of contraceptives. Both vaccines and contraceptives carry an unavoidable risk to a very small percentage of users. Some policymakers have suggested a national fund to compensate the few individuals who sustain damage from these otherwise safe and effective drugs.

Finally, federal agencies such as the NIH and the Department of Health and Human Services should increase funding for contraceptive research and services. There is no reason why the United States should lose its leadership status in this area. And there is certainly no reason why women in this country must bear unwanted children because they do not have satisfactory options for birth control. □

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Our scientists developed the system's technology and equipment, and have been contributing to the state of the art ever since.

Current projects deal with increasing the capacity, the versatility, the applications of the systems; longer-term, we are exploring the possibility of all-optical systems.

Faster and faster...

Until recently, optical systems processed digital streams at speeds ranging up to hundreds of megabits per second.

Fast though that may seem, today's carriers are seeking speeds in the gigabits-per-second range. This might even permit the glass to be brought directly to satellite earth stations or microwave towers, for example, for direct conversion of radio signals to light.

Recently, GTE demonstrated the ability to turn diode lasers on and off at rates as high as 20 gigabits per second—about 333% higher than the greatest previously recorded speed.

...and smaller and smaller.

Such speeds require very special lasers. And, as you can see from the electron micrograph at upper right (the head of an ant looking at one of these lasers), it is extremely small.

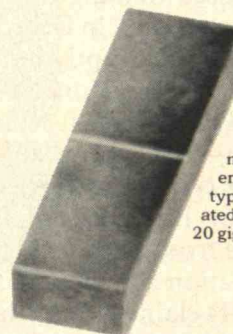
It was constructed on a wafer of InP, by epitaxial growth of a layer of InGaAsP approximately 0.1 micron thick. This was then etched to a mesa shape, and further layers of InP added.

The resulting laser cavity is approximately 0.2 square micron in area, and provides an excellent mate for single-mode glass fiber (fiber with a core of such small diameter that light travels a single path—mode—drastically lowering its dispersion within the fiber).

Switching light with light.

In another project, we are investigating the possibility of ultimately eliminating the electronics altogether by using optical switches.

We are working with materials whose indices of refraction vary with the intensity of incident light—a nonlinear response.



Head of an ant dwarfs a sub-micron-sized diode laser in this electron micrograph. GTE scientists developed this type laser, and have operated it at rates as high as 20 gigabits a second.

Ultimately, if it actually does become possible to switch systems optically, an improvement in speed of as much as 1,000,000% is theoretically possible.

In its brief history, fiber optics has made astonishing strides. At GTE, we are working to continue at the frontiers of this science—to make fiber optics an even more helpful technique to meet the endless needs of tomorrow's telecommunications.

The box lists some of the pertinent papers GTE people have published on various aspects of fiber optics. For any of these, you are invited to write GTE Marketing Services Center, Department FO, 70 Empire Drive, West Seneca, NY 14224. Or call 1-800-833-4000.



Pertinent Papers

High Frequency Modulation on InGaAsP Lasers: R. Olshansky and C.B. Su, 5th International Conference on Integrated Optical Fibre Communications—11th European Conference on Optical Communications, Venice, Italy, October 1-4, 1985.

140 Mb/s Transmission over 30 KM of Single-Mode Fiber Using an LED Source: L.W. Ulbricht, M.J. Teare, R. Olshansky, and R.B. Lauer, 5th International Conference on Integrated Optical Fibre Communications—11th European Conference on Optical Communications, Venice, Italy, October 1-4, 1985.

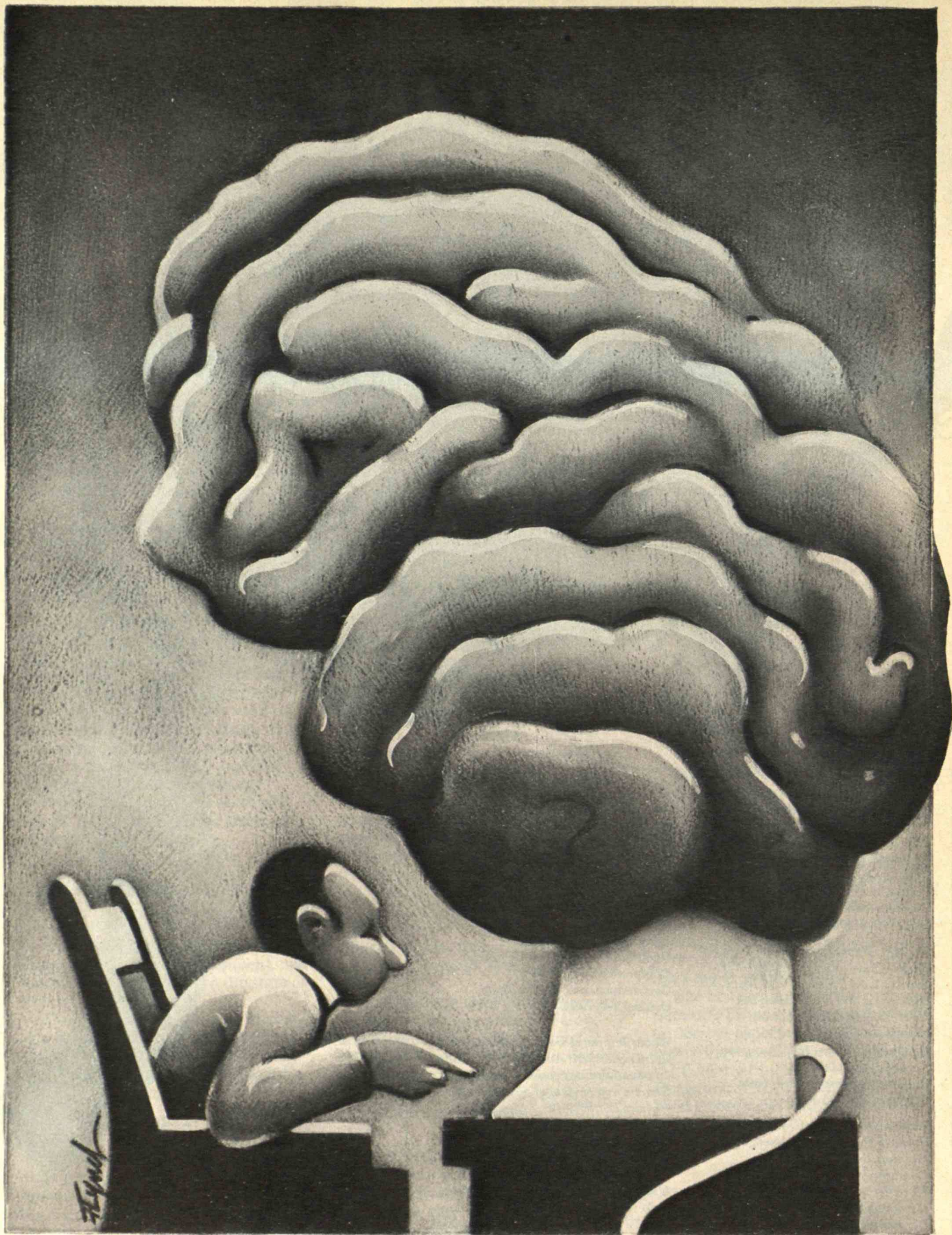
Tunable Multiplexer/Demultiplexer: Barbara Foley, John Carlsen, Paul Melman, 5th International Conference on Integrated Optical Fibre Communications—11th European Conference on Optical Communications, Venice, Italy, October 1-4, 1985.

Frequency Modulation and Dynamic Lineshape Properties of Single Mode Semiconductor Lasers—Time Averaged Electric Field Autocorrelation Function Measurements: Elliot Eichen, Paul Melman, William H. Nelson, 5th International Conference on Integrated Optical Fibre Communications—11th European Conference on Optical Communications, Venice, Italy, October 1-4, 1985.

Room Temperature Optical Bistability in InGaAsP/InP Amplifiers and Implications for Passive Devices: W.F. Sharfin and M. Dagenais, *Applied Physics Letter* 46(9), 1 May 1985.

Time and Wavelength Resolved Nonlinear Optical Spectroscopy of a Polydiacetylene in the Solid State Using Picosecond Dye Laser Pulses: G.M. Carter, M.K. Thakur, Y.J. Chen and J.V. Hryniewicz, *Applied Physics Letter* 46(9), 1 May 1985.

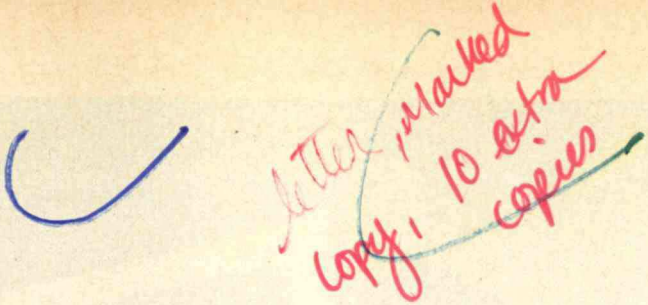
GTE



Designing Computers That Think The Way We Do

BY WILLIAM F. ALLMAN

In a radical departure from traditional computers, researchers are building machines that mimic the architecture of the human brain.



It doesn't look like much: a chunk of wood the size of a chessboard, festooned with wires and electronic components. Still, it's something that physicist John Hopfield keeps in his office and displays with a broad smile. Built by Hopfield and his colleagues at the California Institute of Technology, the board is a physical manifestation of an idea that a handful of theorists have kicked around for years. Their dream is to build a computing machine that operates on an entirely different principle than the step-by-step symbol processing of conventional computers. This machine would be modeled after the brain: a vast network of neuron-like units that operate on data all at once.

Cognitive scientists have succeeded in simulating such "neural nets" on powerful conventional computers, and Hopfield's crude board is one of the first real neural-

net machines. It represents a radical shift in designing computers that think, and it might even change the way we think about thinking.

For decades most artificial intelligence (AI) experts believed that thinking involved the manipulation of symbols—letters or numbers that were in themselves abstract but could be used to express specific ideas or concepts. Take the equation $f = ma$. If you know that f is force, m is the mass of an object, and a is the object's acceleration, these symbols assume a powerful meaning in the real world. Furthermore, there is a consistent set of operations that applies to these symbols. Using algebra, for example, $f = ma$ can be changed to $a = f/m$ and still be true.

If the physical realm of motion and mass can be captured in a set of symbols and rules, then why not the mind? the theorists asked. Might not our cognitive abilities be formalized as a set of operations that would work on a symbolic representation of the world? If we know that everyone at a convention is a lawyer, and that Jane is at the convention, then we can conclude that Jane is a lawyer. This reasoning can be expressed formally as symbols and operations: if all p 's are q 's, and x is a p , then x is also a q . It doesn't matter if we're talking about lawyers or farmers, conventions or state fairs, Jane or Jack. The same rules apply. Theorists believed they could simply translate the world into symbols, manipulate the symbols, and translate the results back into the language of the real world.

Formal systems appealed to engineers and mathematicians as well. In 1937 Claude Shannon, then a graduate student at M.I.T., showed in his master's thesis how the true/false propositions of symbolic logic could be simulated in the on/off states of electronic switches. The mathematician John von Neumann showed how a machine could store data in such switches and use a processor to do one operation at a time. The excitement came to a head in 1955, when Herbert Simon is said to have told his class at the Carnegie Institute of Technology, "Over Christmas, Allen Newell and I invented a thinking machine."

Newell and Simon did not believe that their computer imitated what actually happens when humans think. Rather, they suggested that the workings of

the mind might be better understood if scientists studied the processes of thinking at a more general, theoretical level.

The Limits of Logic Machines

Newell and Simon believed that the main task for AI enthusiasts was figuring out the nature of the symbols and rules the mind uses. For example, what are the rules by which we change words from the present to past tense? What rules do we use to distinguish a table from a chair? Newell and Simon assumed that once the mind's symbols and rules were known, neuroscientists could then figure out how the brain physically produced them.

The people who build neural nets are challenging that long-held assumption. Conventional computers, after all, are having a terrible time making the transition from number and symbol crunching to more formidable tasks such as speech and vision. In fact, computers are awful at these tasks. This failure has led to a growing suspicion that perhaps the people who brought us "I symbol process, therefore I think" might have been putting Descartes before the horse, as it were.

Since some types of thinking such as formal logic and arithmetic involve symbol manipulation, it's not unreasonable to conclude that all other types of thinking do, too—even if we aren't consciously aware of it. But might it not be the other way around? Perhaps the lion's share of what we call thinking is something else. Processing symbols could be a sideline, more the exception than the rule, icing on the cognitive cake.

A quick look at the human mind makes you think so. "Our attempts at general-purpose computation [that is, doing arithmetic or logic] are often inconsistent," says Brown University cognitive scientist James A. Anderson. "Far more complex tasks that are biologically relevant [such as using language or rapidly recognizing faces] are so effortless that we do not realize how hard they are until we try to make a machine do them. On the other hand, the pitiful mess most humans make of formal logical reasoning or arithmetic would embarrass a \$10 pocket calculator."

In other words, using a human brain to do symbol processing may be a little like using the head of a wrench to drive a nail. Though it might do the job, a hammer would probably do it better. But unfor-

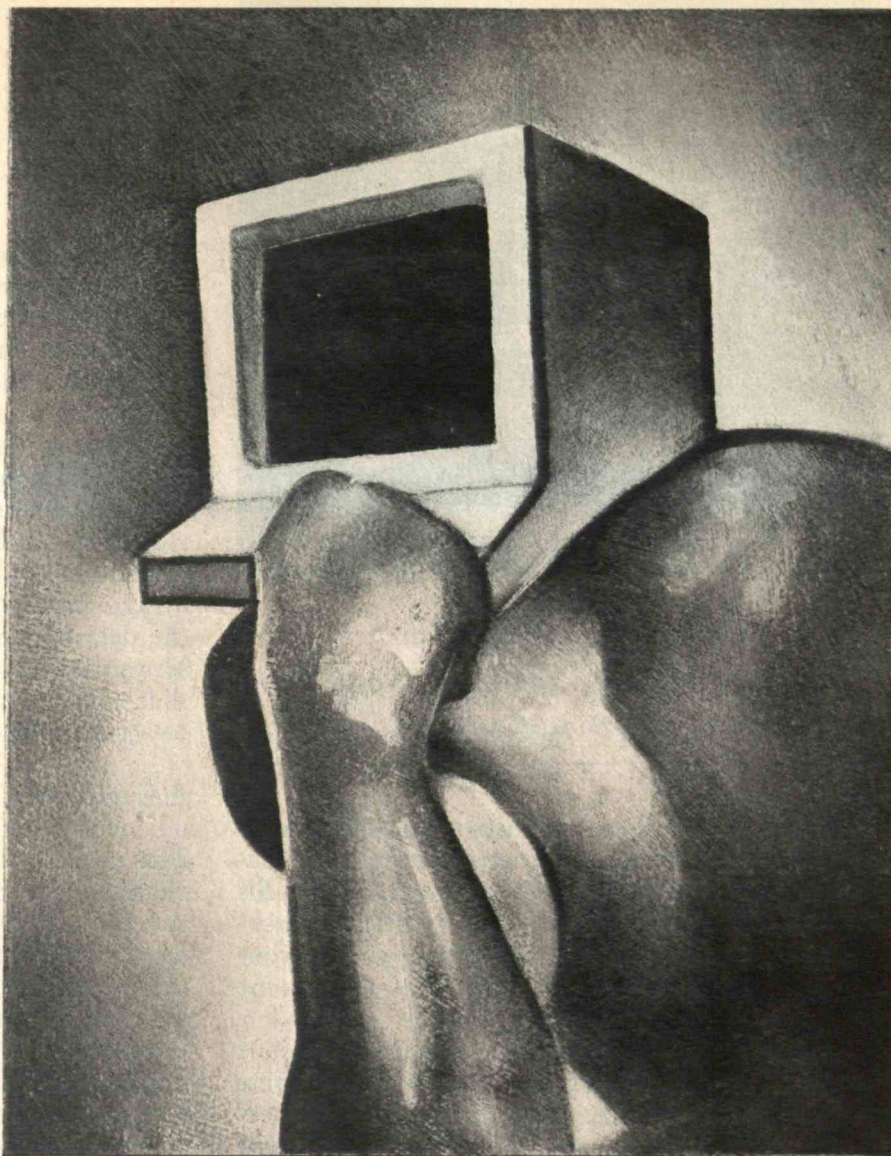
WILLIAM F. ALLMAN is a free-lance writer living in Washington, D.C. He is a former staff writer for Science '86.

tunately, if the only tool you owned happened to be a hammer, you might begin to see every problem as a nail to be driven.

So if thinking isn't symbol processing at its basic level, then what is it? Hopfield and a growing number of computer scientists, cognitive researchers, psychologists, and physicists are trying to find out. Instead of building bigger and faster hammers, they are designing machines based on the hunch that the mind is more wrench-like. For inspiration on how to build the hardware of their thinking machines, they are looking to the hardware of that other thinking machine, the brain.

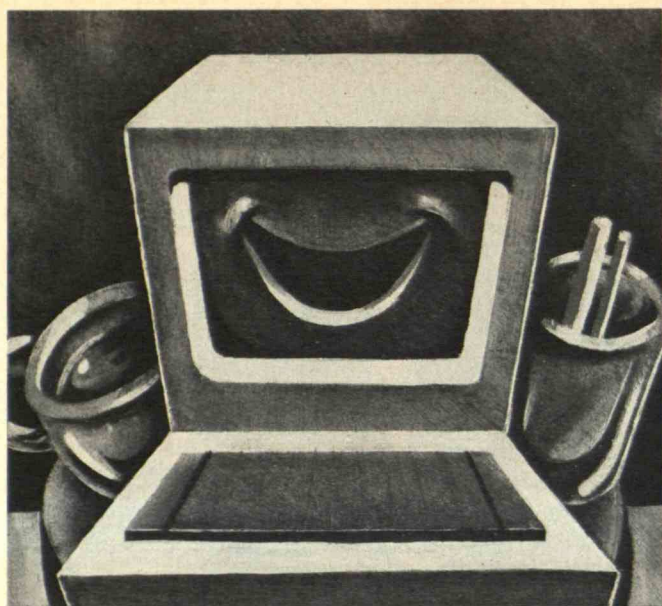
Neuroscientists have come to realize that the architecture of the brain—how its billions of neurons are connected in a complex, three-dimensional maze—is central to its function. Individual neurons aren't especially smart by themselves, but when they are connected to each other they become quite intelligent. The problem is, nobody knows how they do it. It isn't that neurons are fast: in sending their electrochemical messages to other neurons, they are roughly 100,000 times slower than a typical computer switch. But what our brains lack in speed they make up in "wetware," as it is sometimes called. The brain contains from 10 billion to a trillion neurons, each of which may be connected to anywhere from 1,000 to 100,000 others. If this vast net of interconnected neurons forms the grand collective conspiracy we call our minds, maybe a vast interconnected net of mechanical switches can make a machine that thinks.

Simple elements often display complicated behavior when they come in large groups. Imagine that you put 2 molecules of a gas such as hydrogen in an otherwise empty, closed container at room temperature. Because hydrogen is a gas, the molecules float around, colliding with the walls and, rarely, with



Using the human brain to do symbol processing may be a little like using the head of a wrench to drive a nail.

each other. "Every once in a while the molecules collide, and that's an exciting event in the life of someone studying molecular collisions," Hopfield says. "If we put 10 or even 1,000 molecules in the box, all we get is more collisions. But if we put a billion billion molecules in the box, there's a new phenomenon—sound waves. Sound waves wouldn't exist without collisions. There was nothing in the behavior of 2 molecules in the box, or 10 or 1,000 molecules, that would suggest to you that a billion billion molecules would be able to produce sound waves. Sound waves are a collective phenomenon of a complex system."



Netalk is one neural-net machine that has learned to recognize speech patterns and read aloud.

Hopfield and other scientists who loosely call themselves connectionists are not trying to make machines that mimic the action of neurons. Nerve cells are far too complex for that. Rather, these researchers prefer to think of their machines as “neuron-inspired,” using “neuronal units” that share some of the brain’s properties.

Like neurons, these units are connected to one another in a huge net. Each unit consists of electronic circuitry that responds to input from the others either by switching on and off or by amplifying and diminishing a signal. The units receive incoming electrical or optical messages, add them up, and decide whether to send messages of their own. In the simplest device, the inputs are added up and compared to a certain value. If the sum of inputs is below that value, there is no output.

The conventional von Neumann-type computer takes a few bits of data at a time from a separate memory storage and then operates on them with a central processor, but in neural nets the interconnected units all act on data at once. Like the human brain, they engage in what is called massively parallel computation.

In a seminal paper published in the *Proceedings of the National Academy of Sciences* in 1982, Hopfield showed that the way a network of switches behaves could be mathematically analyzed with the same tools that physicists use to analyze dynamic physical systems. His thesis is complex, but to make a rough analogy: Like a heated bar of metal that hardens as it cools off, a neural net whose switches

have started to turn on and off at random will also go through a stabilizing process.

As its units communicate, the net eventually will settle into a state where each switch is permanently set in either the on or the off position. The significance of this becomes clear when we remember that neural nets, like conventional computers, encode information in such switches. For instance, the letter A could be represented as 10001, and 10001 can be stored in on/off switches as on/off/off/off/on. A neural net could recognize the letter A through an array of sensors that signal on or off depending on the data they receive. The final output would be a series of 1s and 0s. Because neural nets work like that, the stabilizing process can indicate the answer to a particular problem.

A Computer That Guesses Right

This process also gives neural nets the data-sorting characteristic of a “content-addressable,” associative memory. Our own memories are content-addressable. We can fetch a whole set of facts from a fragmented or even partially incorrect input. When we think of our friend Sally, for example, we also remember that she is a doctor, lives in Pittsburgh, and has red hair. Sally may also come to mind when we think of redheads or doctors or people who live in Pittsburgh. So if someone asks, “Don’t you know a redheaded doctor who lives in Philadelphia?” there is enough correct information to conjure up Sally and say, “No, Pittsburgh.”

It’s tough to make a conventional computer do this, but for neural nets it’s natural. If one stable arrangement of the net’s on/off switches represents an assortment of related information—*Sally, doctor, red hair, lives in Pittsburgh*—the whole memory can be retrieved by putting in any part of it. Given the input *Sally* and *doctor*, the units will settle into the configuration that represents *red hair* and *Pittsburgh*. In fact, only 5 percent of the memory is enough to make the rest of the system settle into a stable state representing the whole memory.

The net will even make a good guess on the basis of faulty input. Thus if it is given a *red-headed doctor who lives in Philadelphia*, it might still come up with *Sally*.

Again unlike a conventional computer—and very much like our minds—neural nets produce answers that are pretty good but not always the very best.

With some tasks, perfection may not be worth the extra time and effort, especially if there are good answers that can be found quickly.

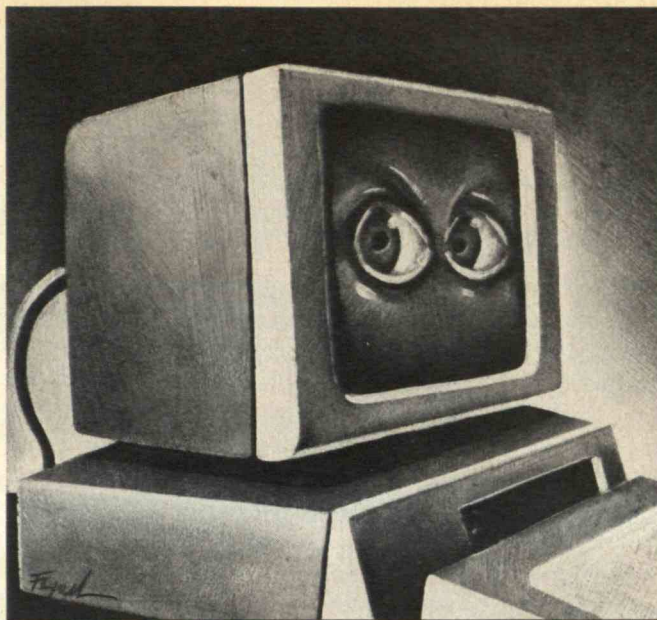
The Traveling Salesman Problem

One such task is solving the “traveling salesman problem,” which crops up in everyday situations ranging from deciding on routes to making up airline schedules to designing microchips. Suppose you were a sales representative and had to visit 10 cities. What would be the shortest route you could take to visit them all? It turns out that it is mathematically possible to take 181,440 different routes to visit any 10 cities. To find the shortest one might be manageable, but as the number of cities to visit goes up, the number of possible routes skyrockets. If you wanted to visit 100 cities, for example, there are more than 10^{100} routes. Though digital computers can solve this problem with sophisticated programs, their strategy is to simply measure each route one by one, and that takes a lot of time.

With a neural net, you need only adjust the connections between units to represent the distances between cities. On the few neural-net machines that actually exist—like Hopfield’s board—these adjustments are made by hand. The varying strength of connections is manifested as resistance in a wire or some other electronic trickery that reduces or amplifies currents. In neural nets simulated on conventional computers—which is far more common at this stage—a simple factor in multiplication or addition does the job. Within a few millionths of a second, the switches will settle into a stable state, indicating a short route—and a solution to the traveling salesman problem.

In one experiment by Hopfield and his associate at Bell Labs, David Tank, a neural net found answers to traveling salesman problems 1,000 times faster than a conventional computer did. While these answers were the very best only 50 percent of the time, the net came up with one of the two best answers 90 percent of the time.

Absolute accuracy may not always be ideal. Reaching a good working solution fast—rather than struggling for a long time for the best answer—may be more effective in finding the shortest way to route telephone lines or creating a compact design for a microchip. Speed would also be more important than perfection for machines designed to recognize pat-



*Since they can
recognize patterns, neural nets could
give robots “vision.”*

terns and make generalizations.

The same principle applies to the way we think. “Biology by and large is not interested in finding the best things, just things that are pretty good that can be found quickly,” Hopfield says. For example, speech experts estimate that we actually understand only about 70 percent of the words we hear. Our minds fill in the rest from the context of what’s being said.

Another mind-like trait neural nets display almost borders on intuition. The systems can, for instance, make inferences from ambiguous language. “If you hear the words *bat*, *ball*, and *diamond*, you think of one thing,” says Brown University’s Anderson, who works with neural nets. “And if you hear the words *bat*, *vampire*, and *blood*, you think of another.” Given *bat* or *diamond* alone, Anderson’s machines will respond with characteristic qualities of animals or geometric shapes. But if *bat* and *diamond* are put together, the machine comes up with *baseball*.

It is possible to program a conventional computer to make some of these inferences. However, a neural-net system has a natural ability to form categories and associations, because information about specific objects is spread out among the connections. The net stores the fact that a bat is both an animal and an instrument used in baseball, and the fact that a diamond is both a geometric shape and a baseball-playing field. As a result, the system is able to associate bat and diamond as being two common traits in baseball.

Neural nets have the potential to produce a new

*Neural networks might be ideal
for nuclear power plants or spacecraft, where a sudden
breakdown could be catastrophic.*

kind of artificial intelligence. Instead of relying on the rules an expert might use to make decisions, these machines can learn from a series of examples. For instance, a network repeatedly shown the present and past tense of certain verbs will eventually learn to change the tenses on its own—even for words it hasn't seen before.

It accomplishes this by following a series of "algorithms," or learning rules. Such rules work roughly on the principle that if two neural units cooperate to produce the right answer, the strength of the connection between them is increased. Likewise, if two units produce a wrong answer, then the connection between them is decreased.

Machines That Make Their Own Rules

NETalk is one machine that can learn through algorithms. Built recently by Johns Hopkins biophysicist Terry Sejnowski and Charles Rosenberg of Princeton, NETalk is a 200-unit neural net that has learned to read aloud. With a conventional computer, a programmer would have to sit down and write a series of rules, such as "when you come to an *s*, make an *s* sound; an *n* makes an *n* sound." Of course, there are exceptions to the rules as well: for example, making the *s* silent when it's next to another, as in "passing." And that doesn't explain what to do with the *s* in "passion." But it's possible, with enough perseverance, to track down most of the rules and most of the exceptions, though a word like "knack" might send a system into paroxysms. Most speaking machines take a shortcut, consulting first a pronouncing dictionary of 10,000 or so most-used words, then switching to rules if a word is not in the dictionary.

NETalk, on the other hand, started with an input of written text and the ability to drive a speaker. But it didn't have any rules for matching letters with sounds. It had a learning algorithm instead.

For its first training session, NETalk was given a 500-word text of a first-grader's recorded conversation. The correct sounds for the child's speech—divided into units called phonemes—were already known because they had been transcribed by a linguist. As NETalk read the text, its network chose phonemes to represent the letters. Meanwhile, its learning algorithm compared those phonemes with the ones the linguist had transcribed. Whenever differences appeared, the algorithm adjusted the

strength of the connections between various neural units to try to make the network produce a phoneme that was a better match.

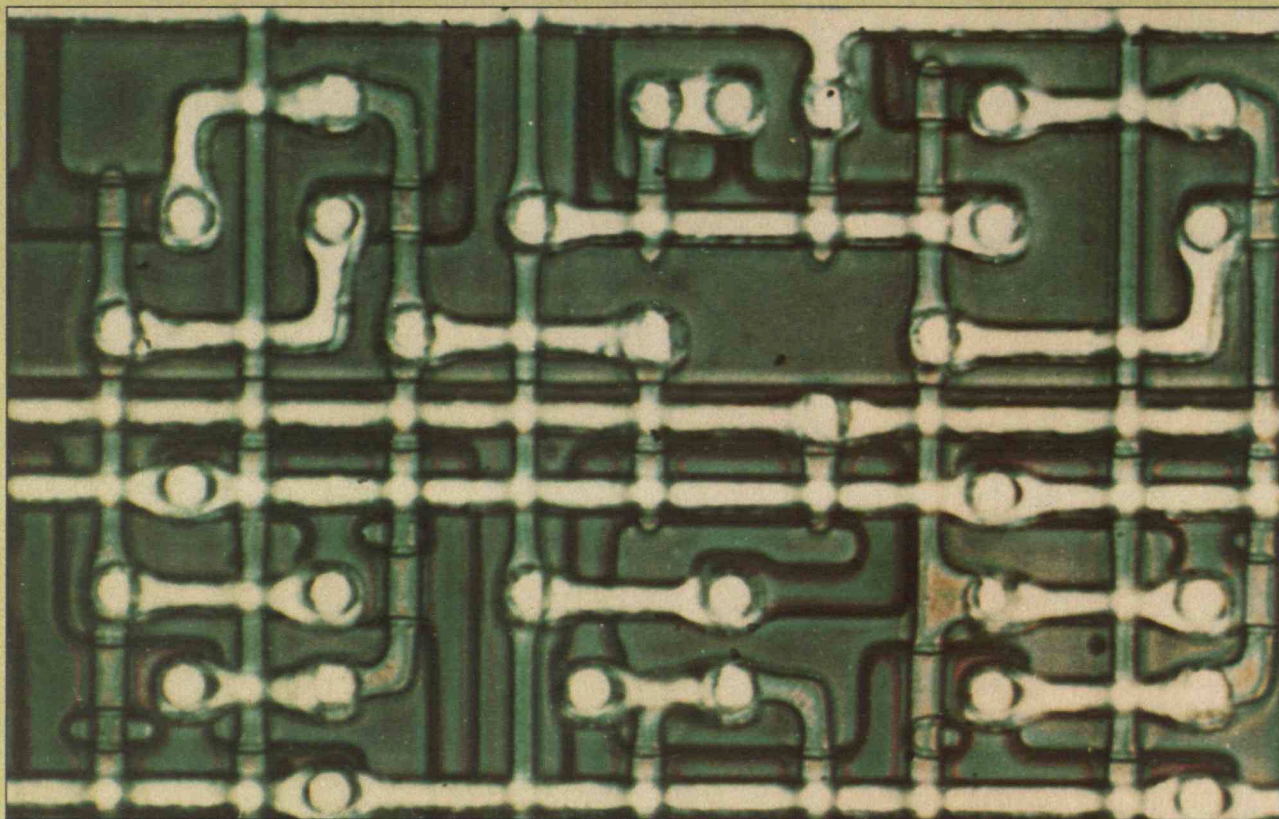
At first, NETalk could only babble. But after a day of training it could read any text with about 90 percent accuracy. In a way, NETalk still has rules for pronunciation. But it makes them itself, adjusting the myriad connections in the machine to make the best fit. "The rules aren't put there," says Sejnowski. "They emerge."

Computers That Don't Crash

Cognitive scientists are using neural nets to explore not only associative memory but other aspects of thinking as well. At Carnegie Mellon University, Geoffrey Hinton is working on a network that makes generalizations about the relationships in a family tree. Cognitive scientists David Rumelhart of the University of California at San Diego and Carnegie Mellon's Jay McClelland are looking at the way networks perform language-related tasks, such as changing the tense of verbs. And Carnegie Mellon's David Touretzky, collaborating with Geoffrey Hinton, is demonstrating that neural nets can even do the kind of sequential symbolic processing that ordinary computers do.

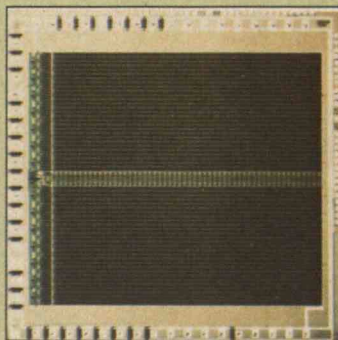
At this stage, connectionist machines are usually simulated on conventional computers because no one is sure what the best configuration for neural nets might be. However, researchers at Bell Labs have constructed an experimental "neural net" chip that has 75,000 transistors in an area the size of a dime. Furthermore, the concept has piqued the interest of the Pentagon's Advanced Research Projects Agency, the Jet Propulsion Laboratory, AT&T Bell Laboratories, and Los Alamos National Laboratory. Researchers at all of these organizations are now attempting to put theory into practice and build neural-net machines that are more sophisticated than Bell Labs' chip or Hopfield's board.

Defense agencies are particularly interested in neural nets because such systems have a brain-like property known as "graceful degradation." Since information and processing are distributed among many neural units, a neural net can still function—though somewhat less efficiently—when as much as 15 percent of its units are damaged. A similar occurrence would be disastrous for a conventional computer. "Cut 1 percent of the wires in a com-



AT&T's Bell Labs has built a neural-net chip that contains 75,000 transistors in an area the size of a dime. The photomicrograph at right shows the circuit of the chip, which con-

tains 54 "neuronal" units in a matrix of "synapses." These programmable synapses regulate the flow of electricity between neuronal units. Above is an enlarged view of a synapse.



puter," says Hopfield, "and it will grind to a halt."


Such resilient networks would be ideal for spacecraft, nuclear power plants, or Star Wars, where a sudden breakdown could be catastrophic. And because of their potential strengths in speedy pattern recognition, neural nets are being considered as vision and speech-recognition systems for robots.

Neural nets are still very much in the experimental stage, and many cognitive scientists remain skeptical about their potential. Stanford AI researcher Terry Winograd, for one, says the machines are receiving attention now because "they have a higher percentage of wishful thinking."

Even with all the excitement over the promise of neural-net computers, it's unlikely they will replace the good old number crunchers that we've grown so used to over the decades. As traditional AI propo-

nents point out, relying on machines that think the way we do may not be such a great idea. You certainly wouldn't want to balance your bank account or figure out a company payroll with a computer that does not consistently produce the best answer.

Yet many researchers feel neural nets will enhance our understanding of how the brain works and help us build better AI systems. Indeed, if these systems really can recognize patterns and make good inferences from sketchy and partially incorrect data, they might serve as bridges between the sloppy, intuitive human world and the more literal and precise realm of conventional computers. Sometime in the distant future, when we ask our personal robot to go fetch a bat, its neural net might be responsible for determining whether we are about to go to a Halloween costume party or a baseball game. □



Cassiopeia A, a supernova remnant, as revealed in three wavelengths. The green shows the x-ray emissions typical of the debris from a star that has undergone a violent explosion, the blue reveals radio waves, and the red represents visible light.

Letter, marked copy, + 10 extra copies to author

Observing the Energetic Universe

BY DAVID H. SMITH

HUMANITY'S conception of the universe has changed radically in a few scant years. At the end of World War II astronomers could view the cosmos only in the visible part of the electromagnetic spectrum, and then only imperfectly through Earth's murky atmosphere. Put simply, astronomers of that era were largely color blind. Yes, they could see the colors red to violet, but they could not see ultraviolet or infrared light, x-rays or radio waves.

Today, with access to data garnered from the longest radio waves to shortest gamma rays, astronomers can see the universe in technicolor. Each wave band tells a unique story about the heavens.

For example, the gas and dust found among the stars—the stuff from which they are made—emit mostly infrared radiation, not visible light. Data collected by the Infrared

Astronomical Satellite in 1983 showed that several nearby stars are surrounded by disks of cool matter that may be solar systems forming.

At the other end of the optical spectrum, ultraviolet radiation tells us about our Sun's hottest relatives—the blue and white stars that outline the spiral forms of galaxies like our Milky Way. Ultraviolet radiation also illuminates the tenuous matter surrounding hot young stars, and the delicate shells of material cast off by red giants as they turn into white dwarfs.

Energetic x-ray emissions from hot gases and colliding particles reveal still more violent processes. Matter torn from one star by the ultrastrong gravity of a close companion, the million-degree gas that leaks from the Sun as solar wind, and the gas convulsed by a supernova explosion are but a few of the many sources of cosmic x-rays.

The violence of such events—and what they reveal about the behavior

*X-ray astronomy
has helped spark a revolution in humanity's view of the cosmos.
Yet budget cutbacks and the Challenger disaster threaten
to curtail further progress.*

The last major x-ray satellite ceased operating in April 1986.

of matter under the most extreme conditions of temperature, density, gravity, and magnetism—has tested physicists' theories to their limit. For example, accurate timing of the pulses of x-rays emitted by some double-star systems has vindicated the basic assumptions of relativity. Studies of the emissions from the tenuous matter in the farthest depths of the intergalactic void promise to reveal much about the ultimate fate of the universe.

This surge of new information, particularly from x-ray studies, has caused a revolution in astronomy that has affected the thinking of people everywhere. Arcane concepts such as black holes, discovered by x-ray researchers, now figure in our general vocabulary.

But just when astronomers should be reaping the full benefits of their newfound vision, federal budgetary cutbacks and the upheavals caused by the *Challenger* disaster threaten to curtail the satellite projects needed to continue this work. X-ray astronomy, one of the most dynamic and productive of the new sciences, has been particularly hard hit. Unlike radio and optical waves, this high-energy radiation cannot penetrate Earth's atmosphere. Researchers are therefore almost totally dependent on data collected by satellites. But the last major x-ray satellite, the European Exosat, ceased operating in April 1986.

The last U.S. satellite burned up in 1981. The next major project with substantial U.S. participation is the German Rosat. Originally scheduled for launch by the shuttle this October, Rosat is not expected to reach orbit before the early 1990s. (There is a slim chance it will be launched earlier on an expendable booster.) Europe has planned a new X-Ray Multi-Mirror mission, but funding for this, too, may not materialize until the 1990s. The great hope of the x-ray community, NASA's highly sophisticated Advanced X-Ray Astrophysics Facility (AXAF), has suffered many delays and is still awaiting final funding. The backlog of payloads on NASA's schedule has also forced the cancellation of many small projects designed to give ready access to space.

Elsewhere the situation is not totally bleak. Japan's third x-ray satellite, Ginga, was launched February 5. The Soviet Union also has ambitious plans to link a 20-ton astrophysics module containing an

array of x-ray telescopes with its Mir space station. Both projects are less sophisticated than AXAF, but they will supply useful data when there is little else available.

Both Ginga and Mir entail substantial international cooperation. Many of the instruments to be flown by the Soviet Union have been supplied by European scientists. American researchers are also involved in cooperative projects, with their participation in Ginga especially welcome. "But the Japanese want somebody to work with them in Japan for an extended period," since it takes time to become familiar with the satellite's systems, a leading American x-ray astronomer points out. "This is very difficult for established researchers with other commitments."

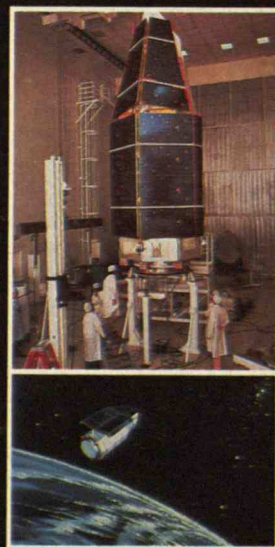
Without the instruments to follow up tantalizing observations made with the last generation of satellites, scientists have been forced to sift through old results in hope of finding something new. Some major discoveries have been made this way: late last year Exosat scientists announced that they had found a pair of stars that orbit each other every 11 minutes. These stars must be very close—enough to fit comfortably in the space between the Earth and the Moon! This finding has supplied much new information on the origin of x-ray-emitting double-star systems.

But mining old data cannot continue forever. Future prospects are "very grim at the moment," according to Nicholas White, Exosat's project scientist. He laments that young researchers and experienced technicians "are just leaving astronomy completely" because of the lack of new projects. He fears that "when we get the next big satellite in orbit we will have to learn everything over again."

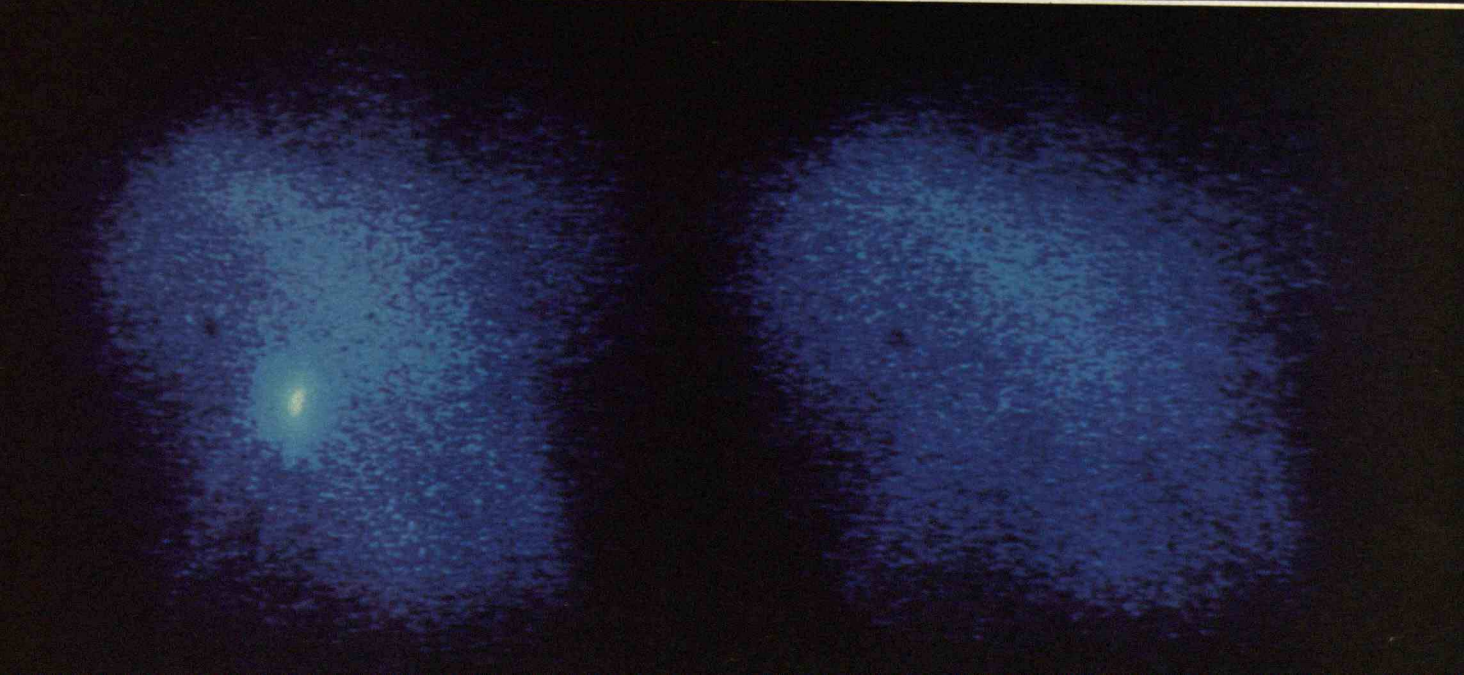
Discovering the Violent Universe

For most of this century—as in ages past—humanity's perception of cosmic activity was reflected in phrases such as "the harmony of the spheres" and mechanical analogies such as "celestial clockwork." The cosmos seemed to display a timeless order: stars formed, lived their lives, and died. A very few died in spectacular supernova explosions like the one recently discovered in the Large Magellanic Cloud, but most departed with a whimper. This view was enshrined as a virtual law of nature in the leading cosmological theory of the time: that of the Steady State universe. This theory postulated a cosmos that had always existed and always would.

Right: An optical image of the Crab nebula, the debris of a supernova seen by Chinese astronomers in 1054. Below right: Two x-ray images of the Crab reveal a pulsar—a rapidly spinning, ultra-dense star—at the nebula's core. The pulsar emits bursts of x-rays like flashes from a lighthouse. (The "on" phase is depicted at the left, the "off" phase at the right.) Below left: The Einstein Observatory, a major U.S. x-ray satellite launched in 1978, is shown here under construction and in flight (artist's conception).



DAVID H. SMITH, associate editor of *Sky and Telescope*, has a D.Phil. in theoretical astrophysics from Sussex University.



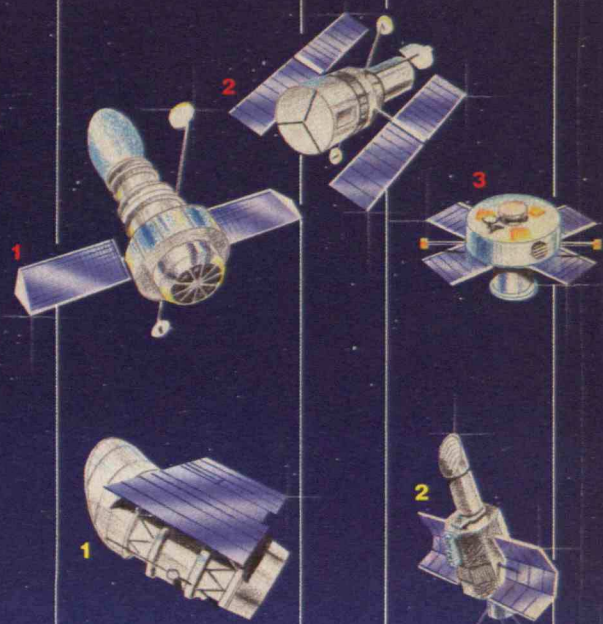
This drawing of the electromagnetic spectrum shows the various instruments used to detect cosmic radiation in each wavelength. Radio and optical waves are the main kinds of radiation that reach the Earth's surface (some infrared reaches high mountain-tops). Instruments to detect other wavelengths must be launched above or high into the atmosphere.

FUTURE MISSIONS

- 1 SPACE INFRARED TELESCOPE FACILITY
- 2 HUBBLE SPACE TELESCOPE
- 3 EXTREME ULTRAVIOLET EXPLORER
- 4 ADVANCED X-RAY ASTROPHYSICS FACILITY
- 5 GAMMA-RAY OBSERVATORY

PAST AND PRESENT MISSIONS

- 1 INFRARED ASTRONOMICAL SATELLITE
- 2 INTERNATIONAL ULTRAVIOLET EXPLORER
- 3 EINSTEIN OBSERVATORY
- 4 BALLOONS



100 kilometers:
Limit of
Earth's
atmosphere

Height to which
radiation penetrates



Radio
telescope



Optical
telescope

Radio

Infrared

Visible

Ultraviolet

X-ray

10^2 Wavelengths (meters)

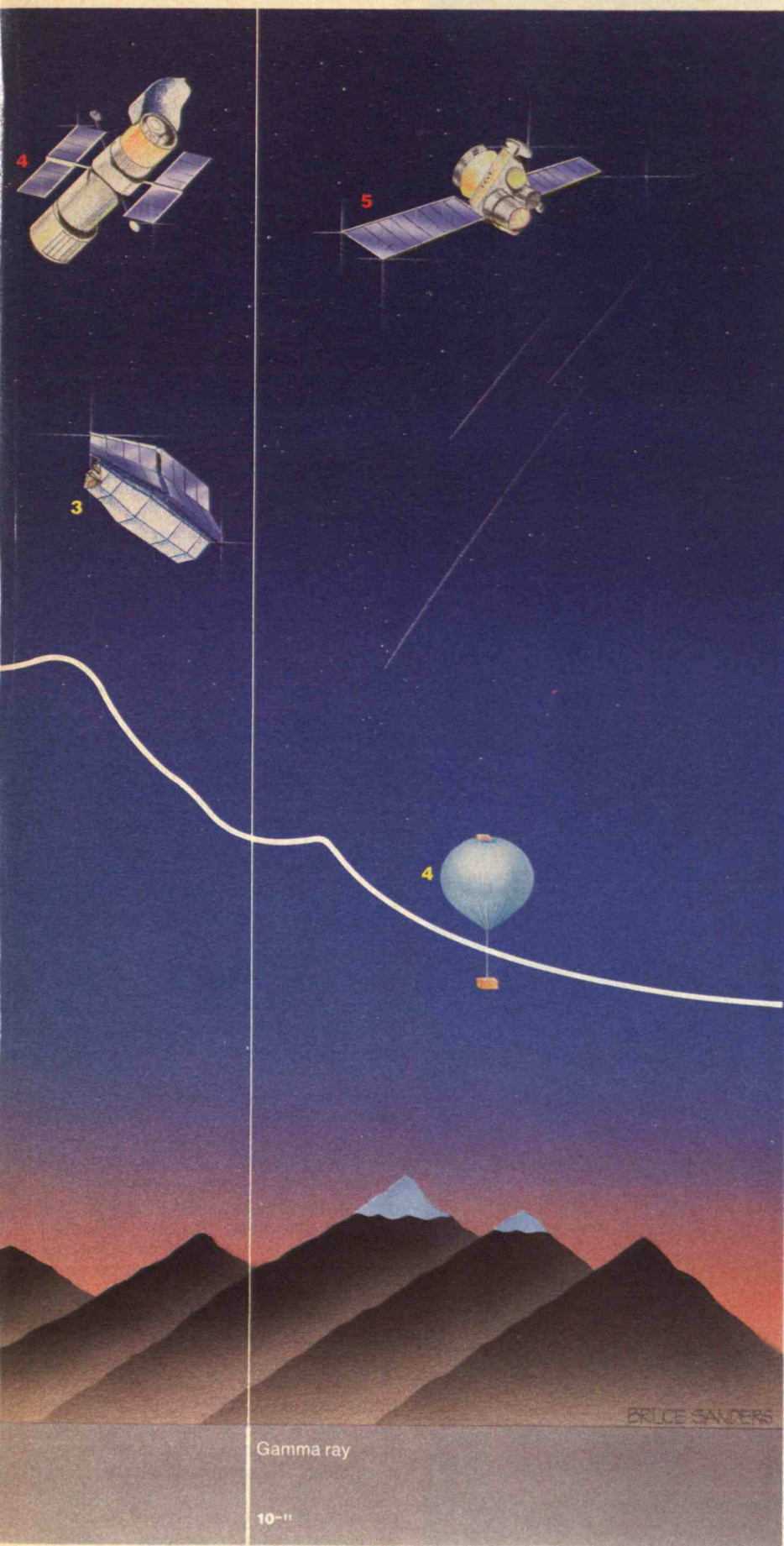
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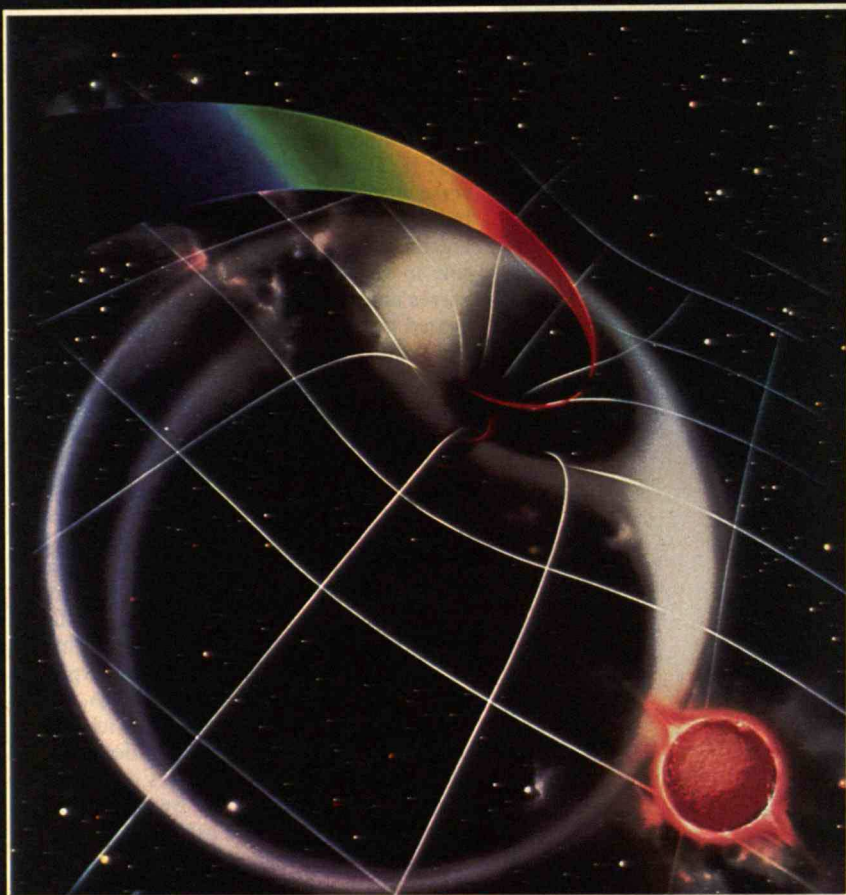
This view began to change after World War II. The first new window on the universe was opened by radio astronomers building on wartime radar research. Energetic processes seemed to play a major role in shaping cosmic structures. Radio waves emitted by matter compressed and heated by shock waves from a supernova, for example, revealed that huge bubbles can be blown in the tenuous matter among the stars. It is highly likely, in fact, that the formation of our solar system was triggered when such a blast wave caused a cosmic gas cloud to contract. Whole galaxies were also found to erupt, and strange starlike objects called quasars—now known to be the objects most distant from Earth—were seen to be emitting stupendous amounts of energy. It was rapidly becoming clear that the universe is not eternal but was created in a titanic explosion some 10 to 20 billion years ago.

As the new viewpoint evolved, an alliance was forged that came to dominate astronomy. Radio astronomers could understand their results only by comparing them with what optical astronomers saw at the same place in the sky. Over the years the distinction among radio, optical, and other kinds of astronomy continued to blur. Many of the new generation of astronomers use a variety of wavelengths to study each type of celestial body.

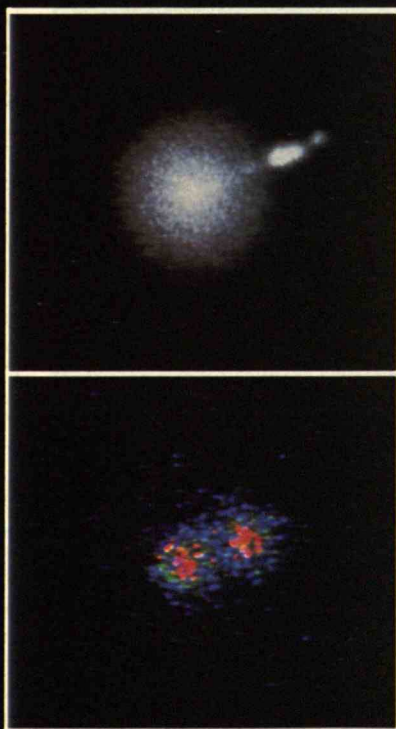
New Fields Proliferate

The success of radio astronomy motivated researchers to explore other wave bands. Because instruments that view the ultraviolet, x-ray, and gamma-ray sky must be lofted above Earth's absorbing atmosphere, wartime developments were once again the key to unlocking the new fields. As early as August 1948, crude experiments carried briefly into space on captured German V-2 rockets revealed the presence of cosmic x-rays. These rays were tracked to their source by Herbert Friedman of the Naval Research Laboratory when the payload of another rocket—a geiger counter and a photocell—showed that they came from the Sun.

By the end of the 1950s it was clear that the Sun's extremely hot corona (visible only during a solar eclipse) was the dominant source of high-energy emissions. Riccardo Giacconi of American Science and Engineering, a fledgling R&D firm in Cambridge, Mass., next used air force funding to look for weak x-rays thought



Above: X-ray astronomers were the first to discover a black hole, which is so dense that not even light can escape. This artist's conception depicts a binary system, in which material from the companion star is drawn into the black hole's gravitational trap. Right: The optical view of galaxy M87 in the constellation Virgo shows a mysterious jet. The nucleus of the galaxy may have undergone a series of explosions that ejected matter and high-energy radiation. The x-ray photo reveals these energetic processes. The left-hand red cluster represents the galaxy's nucleus and the right-hand cluster represents the jet.



to be emitted by the Moon as a result of solar bombardment. This experiment, launched 25 years ago this June, did reveal x-rays, but originating from a point almost 180 degrees from the Moon. More surprisingly, there seemed to be a faint glow coming from every point in the sky.

Giacconi's x-ray source was found to lie in the constellation Scorpius (and was named Scorpius X-1), and another x-ray emitter was later found in the Crab nebula. Giacconi and his colleagues had discovered a whole new family of astronomical bodies: those that emit stupendous amounts of high-energy radiation but little visible light. This revelation electrified astronomers, who could not reconcile the notion of a tranquil universe with a sky aglow with x-ray sources. Thus a dominant goal in astronomy for the next two decades was understanding the nature of the cosmos revealed by these forces.

X-Ray Astronomy Comes of Age

These discoveries couldn't have come at a better time. NASA was just a few years old and eager to establish its scientific credentials. Moreover, it was flush with money because of the post-Sputnik "science-gap" crisis and could afford to devote funds to promising new efforts.

The next step in x-ray astronomy was to launch a satellite so that objects could be studied for hours or days rather than during the brief minutes of a rocket flight. Giacconi was awarded a contract to design and construct a small satellite for this purpose in 1966—an undertaking that would cost tens of millions of dollars. This satellite, named Uhuru (freedom) after it was launched off Kenya's coast on that country's independence day, discovered several hundred x-ray sources. Its data showed that many of the brightest x-ray emitters, including Scorpius X-1, were double stars: the signals revealed periodic variations consistent with motion about another object.

Systems in which two stars orbit each other are not unusual. In fact, a majority of stars have one or more companions. Yet the objects located by Uhuru were unusual in that one of the components was always small and ultra-dense—so dense, in fact, that its gravity could drag matter off its companion and onto itself. As this matter falls into the compact star's deep gravitational well, it is compressed and heats up until its temperature rises to millions

Astronomers were electrified when they discovered bodies that emit stupendous amounts of high-energy radiation.

of degrees—hot enough to emit x-rays.

In most of these so-called x-ray binary systems, the compact object is a neutron star. Such a star is only a few kilometers across yet it contains as much mass as our Sun. A teaspoonful of matter from a neutron star would weigh billions of tons. However, some x-ray data revealed a body far too massive to be a neutron star. The only possible explanation was that Uhuru had discovered an object that physicists had speculated about for centuries: a black hole. The gravity of these stars is so strong that not even light can escape.

Uhuru also discovered clouds of matter lying among the far-flung members of clusters of galaxies. With temperatures of 100 million degrees or more, intracluster gas clouds typically contain as much mass as the galaxies in the cluster. Subsequent studies have shown that such gas clouds may be condensing into new stars in the vicinity of giant galaxies.

At least half a dozen x-ray satellites were launched into orbit over the next eight years. However, all these instruments suffered from two major drawbacks. They had limited sensitivity—they could see only the most powerful x-ray emitters. And they suffered from poor angular resolution—researchers could not locate the object they were observing very precisely. If follow-up optical studies were to be done, more accurate positions were essential.

Sensitivity and resolution would both be improved if x-rays could be focused. Focusing high-energy radiation is a difficult proposition. The wavelengths of x-rays are comparable in size to the spaces between atoms, so they readily pass through conventional lenses and mirrors. However, x-rays can be deflected like ricocheting bullets if they hit a surface at a glancing angle. Special cylindrical mirrors arranged to create this angle can provide resolution comparable to that of an optical telescope.

An instrument with such mirrors was the payload for the second-generation x-ray telescope, launched on *Skylab* in 1973. This project was to be followed by NASA's High-Energy Astrophysical Observatory series—an ambitious program designed to place large x-ray, gamma-ray, and cosmic-ray instruments in orbit in the late 1970s. The complete project turned out to be too expensive for NASA's slimmed-down budgets of the post-Apollo era, and was radically cut back. However, the x-ray telescope was funded and

reached orbit on November 13, 1978. It was named the Einstein Observatory to commemorate the hundredth anniversary of Albert Einstein's birth.

X-ray astronomy came of age with this satellite. It was 1,000 times more sensitive than Uhuru and could pinpoint sources with the accuracy of large ground-based telescopes. Astronomers could track virtually any type of object and study it at their leisure. The satellite detected x-ray emissions from virtually every type of celestial body, and x-ray astronomy went from the cataloguing stage to the modeling stage: Einstein had the sophisticated cameras and spectroscopes to understand what made x-ray sources tick.

The satellite had one major flaw: its orbital lifetime was limited. No sooner were astronomers used to ready access to x-ray data than it reentered Earth's atmosphere. Since that fateful day in April 1981, U.S. astronomers have been without a major x-ray satellite.

Looking to the Future

At about the time Einstein died, a blue-ribbon commission of the National Academy of Sciences was considering the future of U.S. astronomy. This panel assigned the highest priority to the construction of a permanent x-ray observatory in space—the AXAF—in its final report. AXAF would conduct frontier observations in conjunction with the Hubble Space Telescope and the Very Large Array radio telescope in New Mexico. It would be 100 times more powerful than Einstein and take x-ray astronomy into the next century.

Five years after the NAS report, AXAF has still not been given the official go-ahead. The satellite was supposed to advance to the final design and construction phase last June, but lack of funds—AXAF is expected to cost \$1 billion—prevented this. NASA planned to award contracts later this year for building the mirrors and other items requiring long lead times, but the agency's budget released by the administration a few months ago contains no funds for AXAF. The project's planners still hope to get final approval for the project in a year or so.

The delay of the Hubble Space Telescope, which was scheduled to go up on the shuttle late last year, is probably one reason that AXAF has been postponed. It is unlikely that NASA will get the go-ahead for such an expensive mission until it has some experience with the equally

complex and costly space telescope, now scheduled for launch in 1988.

Some researchers, including Los Alamos scientist France Cordova, feel that x-ray astronomers can use this interlude to contribute to other branches of astronomy. For example, techniques commonly used to analyze x-ray observations are virtually unknown outside that field. These methods are now being applied to results gathered by the Infrared Astronomical Satellite in 1983. Cordova and her colleagues also made extensive use of Exosat before its recent demise, and they plan to apply for time on Japan's Ginga. Others take a cynical view of x-ray astronomers' pleas for more funding. One researcher comments, "Money is so tight and new missions are so expensive that NASA responds to the people who make the most noise."

Frederick Seward, chief custodian of Einstein data at the Harvard-Smithsonian Center for Astrophysics, says that "it's good to have a pause between missions. But we really will be in trouble if AXAF keeps on getting postponed forever." □



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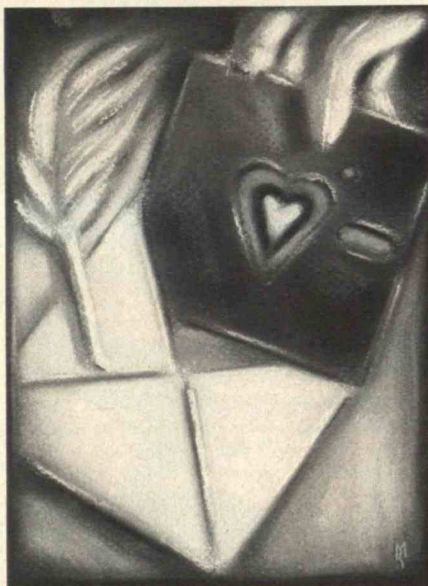
The Calculating Passion of Ada Byron
By Joan Baum
Archon Books, \$21.95

Reviewed by Frances Kirwan

In 1980 the Defense Department named its new computer language ADA in honor of a woman who has been called the world's first programmer, although she died almost a century before the advent of the modern computer. Such a description may be an overstatement, but there is no doubt that Ada, Countess of Lovelace, was a fascinating person. From her father, the Romantic poet Lord Byron, she inherited a speculative imagination and a vivid intelligence. To her mother she owed her passion for the "intrinsic beauty, symmetry and logical completeness" of mathematics. These parental gifts help explain Ada Byron's remarkable ability to grasp the potential of the computer as "highly important for the future wants of science, in its manifold, complicated and rapidly developing fields of inquiry."

In the last 10 years, Ada Byron has been the subject of much interest and three biographies, including English professor Joan Baum's stimulating *The Calculating Passion of Ada Byron*, the most recent study. In her own lifetime and for a long time after, Byron attracted attention not on her own account but because she was the famous poet's daughter—indeed, his only legitimate child. Her parents' separation after only a year of marriage, amid whispers of an incestuous relationship between the poet and his half-sister, was only one of many reasons that her father achieved notoriety. Her mother tried to suppress the Byronic traits in Ada's character by giving her a mathematical education—something of a rarity for women at the time—beginning at age five. Although rebellious at first, Ada developed, in her own words, "a very decided taste, I should almost say a passion," for the subject.

The machine for which Ada Byron wrote what Baum and others consider the first program never actually existed. The design was the brainchild of the versatile British mathematician and scientist Charles Babbage, who called it the Ana-



lytical Engine. He had invented its predecessor, the Difference Engine, to produce numerical tables—such as those needed in navigation and astronomy—by mechanical means. The Analytical Engine was designed to be vastly more powerful than the Difference Engine or any other machines then used to add and multiply numbers. Its design would have allowed it to respond to instructions coded on punched cards by performing calculations. Its response could depend on the results of previous steps: the instructions could be in the form *if a, then do b; if not, then do c*. Thus it could be "programmed" to carry out a calculation without the programmer's knowing exactly what steps would be needed. Not until the 1930s and 1940s would machines with this capacity for "conditional branching" actually be built.

Ada Byron first met Babbage and saw his famous Difference Engine in 1833, when she was 17, but she did not make her contribution until 10 years later. Meanwhile she married and became the mother of three children, in whom she never took much interest. Her husband encouraged her to continue her mathematical studies, which were guided by Augustus de Morgan, a leading mathematician who was completing the first modern exposition of the calculus.

Byron remained in contact with Babbage, and in 1842 she translated an Italian engineer's report on the Analytical Engine.

When Babbage learned of this translation he suggested that she add some elaboration of her own. The last of the seven "Notes" that resulted are the basis for her reputation as the first computer programmer. Byron shows how "an implicit function may be worked out by the engine without having been worked out by human head and hands first." She describes what would today be considered a program for computing a complicated sequence of figures called the Bernoulli numbers, whose derivation requires an enormous amount of complex calculation nearly impossible to do by hand. There is some evidence that Babbage may have assisted her in this work.

The rest of the "Notes" attempt to explain the workings and potential importance of the Analytical Engine. Byron's style becomes almost mystical at times: according to Joan Baum, "the Engine becomes a kind of holy instrument." Byron uses some delightful analogies, such as comparing the algebraic patterns woven by the engine to the patterns of flowers and leaves woven by a mechanical loom.

After publishing her translation and "Notes," Ada Byron produced no more mathematics until her death from cancer at the age of 36. Her last years seem to have been unhappy and purposeless, although she maintained her wide scientific interests. She fell so far in debt from gambling and making loans to her lover that she was reduced to pawning the Lovelace jewels, and she died deeply disappointed that she had accomplished so little of what she had hoped. Babbage appreciated her "excellent Notes," but they had little impact upon her contemporaries or the development of computer science.

An Exception to the Rule

Of course, women of Byron's time were not expected to be interested in science, nor were they usually admitted to universities and scientific societies. Most female scientists of the early nineteenth century, including Byron's friend mathematician Mary Somerville, had to fight to pursue their interests against the wishes of parents and husbands. Byron herself did not suffer this disadvantage. Although her father regarded mathematics with contemptuous incomprehension, he had no part in her upbringing. Later her friends

Letter + marked copy to reviewer
Why did the veterans accept such a low settlement?

encouraged her to pursue her love of the subject, and her high social position removed many obstacles from her way.

Byron was genuinely fascinated by the "vast body of abstract and immutable truths" that make up mathematics, "the language through which alone we can adequately express the great facts of the natural world." Yet to be a creative scientist and make a lasting impact one needs not only enthusiasm and imagination—which Lord Byron's daughter certainly did not lack—but also perseverance and a sure grasp of technicalities.

Baum argues that Byron possessed the needed technical competence, but this is controversial. The mathematician de Morgan told Byron's mother that he was impressed by her daughter's "aptitude at grasping the strong points and the real difficulties," but her letters reveal her struggling for days over relatively elementary problems. "The moment I fancy I have really at last got hold of something tangible and substantial, it all recedes further and further and vanishes again in thin air." She wrote to de Morgan that "you know I always have too many metaphysical inquiries and speculations which intrude themselves, that I never am really satisfied that I understand anything."

Byron threw herself into mathematics with enormous zeal but in fits and starts. This was partly due to her recurrent bouts of illness: she suffered for much of her life from breathing difficulties, "heart attacks," and severe stomach pains. She also inherited from her father a tendency to fluctuate between depression and an exultant state of conviction in her own genius. Moreover, ambitions to become a musician, actor, poet, or experimental scientist would sometimes supplant her desire to be a mathematician.

Ada, Countess of Lovelace, is remembered today for the visionary imagination that led her to comprehend the enormous potential of computers. Her unstable temperament and lack of technical aptitude for mathematics may help explain why she did not fulfill her own potential and significantly advance the development of computer science.

FRANCES KIRWAN is a mathematician at the Mathematical Institute at Oxford University.



Toxic Exposure in the Courts

Agent Orange on Trial

By Peter Schuck

Harvard University Press, \$25

Reviewed by Deborah A. Stone

The mass toxic exposure is to the chemical revolution what the machine accident was to the industrial revolution. Just as the machine accident spawned a new set of legal rules, including workers' compensation, to apportion blame and compensate victims, so toxic exposures are shaking up the system of corrective justice known as tort law.

In a traditional tort case, a single plaintiff and a single defendant fight over a physical injury produced by an observable action or a machine. Today the legal system has to accommodate personal-injury suits with thousands and even millions of claimants and entire industries as defendants. The causes of these injuries, which range from cancer to genetic defects, are poorly understood and can often be inferred only through statistical studies.

In *Agent Orange on Trial*, Yale law professor Peter Schuck has crafted an extraordinary case study of the class-action suit Vietnam veterans brought against the defoliant's manufacturers. The veterans

claim that the dioxin in the substance used to destroy vegetation caused a number of long-term health effects that the companies knew could occur. Schuck cites several reports completed before the United States employed Agent Orange in Vietnam showing its potential to cause injury.

Schuck offers an engaging narrative of the trial that reveals the incredible complexity of a major class-action suit. The plaintiffs had to build coalitions among rival veterans' organizations. They continually had to raise large sums of money from lawyers and other investors who hoped to receive a percentage of the award. The numerous lawyers developed their own management structure, with teams handling various aspects of the trial. This setup constantly threatened to fall apart from the pressure of personality conflicts and contrasting strategies; the lawyers even engaged a management consultant to review their finances and administration.

The veterans and their lawyers hired an army of statisticians, epidemiologists, and physicians, as well as hundreds of support staff, to help them prove that Agent Orange caused their illnesses and their children's birth defects. The plaintiffs also commissioned a poll of potential jurors to predict their attitudes toward the case, and set up a mock jury to test the arguments.

The chemical companies tried to hide behind a shield of immunity by claiming that they had produced Agent Orange to government specifications, and that the government knew as much as they about its dangers. (Although the military used the chemical despite scientists' warnings, soldiers are barred from suing the government for injuries incurred during service.) But rulings early in the case went against the manufacturers.

Schuck reconstructs the story from interviews with the key participants and lets us in on conversations behind closed doors. And that is where the ultimate deal was struck. The parties settled out of court for \$180 million—a bargain for the manufacturers, by most accounts. They had been prepared to pay far more and would have been at risk for billions of dollars had the veterans won a jury trial.

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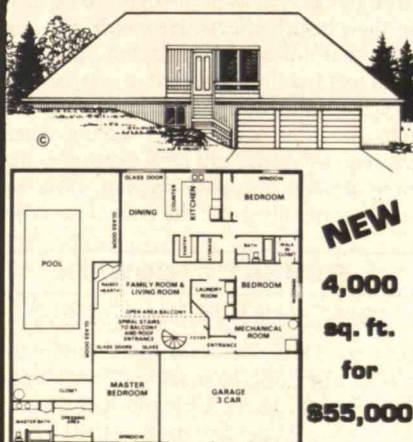
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mendous power to frame the legal issues and control the timing of the case. He used his power to push the parties toward settlement. He warned the defendants that they might not fare well before a Brooklyn jury sympathetic to the veterans' cause, and he intimidated to the plaintiffs that they would fail to convince a jury that Agent Orange had actually caused their health problems. He also set an accelerated trial schedule that would have made it difficult for the veterans to develop a solid case.

Reforming the Tort System

Both the settlement and the legal decisions that led to it are being challenged, and none of the fund has been distributed. In analyzing the process that led to this outcome, Schuck recommends moving away from the tort system as a way of regulating chemical hazards and compensating their victims—largely because of the massive costs in time and money it entails. He believes that workers' compensation, social security, and private disability insurance provide adequate compensation to people who are covered. He would therefore expand this coverage to more individuals, perhaps through collective bargaining and by requiring people to purchase their own coverage. He would have the government provide insurance to those who could not afford it and are not otherwise covered.

However, the organizations that are supposed to insure victims of toxic exposure—in this case, the Veterans Administration—often reject claims for new

kinds of injuries. The victims can press the insuring organizations to recognize their disease as compensable, but bringing tort suits helps them make their case.

Schuck also would enhance the incentives for parties in tort suits to settle out of court—essentially by limiting the legal strategies that defendants can use. He presumes that claimants would be happy to trade off the uncertain prospect of a large jury award, obtainable only after an investment of much time and money, for the certainty of immediate reward. This, of course, is exactly the sort of bargain between labor and management that created workers' compensation in the early part of the century.

Yet it is precisely because the awards available through workers' comp and its effects on workplace safety are so inadequate that people have sought justice in the courts. Product-liability suits have mushroomed because individuals, prevented from suing employers under workers' comp, sue the manufacturers instead.

Schuck further calls for a familiar assortment of regulatory reforms. He would enforce existing laws on the use and disposal of hazardous substances more strongly, as well as perform more research on their health effects. He would also give firms that adhere to regulations immunity from tort liability. It's hard to quarrel with these recommendations, but they will not help much in cases such as the Agent Orange, asbestos, and DES exposures that have already occurred. Indeed, these examples only illustrate the enormous polit-

ical pressures on government *not* to regulate the use of dangerous substances.

An alternative solution, called the "public-law" approach, would make greater rather than lesser use of the tort system but adapt it to the exigencies of the modern toxic exposure. Judges would take a more active role in managing large suits, and courts would be more willing to assign liability on the basis of statistical evidence. Plaintiffs could receive compensation based on increased risk of injury—possibly using the award to monitor their long-term health for carcinogenic effects. The law, recognizing that some injuries cannot be traced to discrete actions, would design a system for holding corporations collectively liable for personal injuries.

Tort suits will and should retain their value because they are a vehicle for social change in a way that simple insurance programs are not. Product-liability suits allow a community to examine explicitly whether and how the behavior of individuals and organizations causes harm, focusing attention on the actors who have control over conditions that cause suffering. In rendering judgments on those questions, tort suits provide some guidance to people who make choices that affect the welfare of others.

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ROBERT C. COWEN

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ment of Energy says it will redistribute funds already requested for other budget items. But if that means rejiggering the high-energy physics budget, it would probably further crimp Fermilab and SLAC operations. It could also starve particle physics research elsewhere.

Obviously, the United States can no longer afford to pursue every line of space and particle-physics research that scientific and technological advances allow. Neither can any other country. Roald Sagdeev, director of the Space Research Institute in Moscow, says "there is a great deal of necessity to join efforts" in exploring the solar system. He adds, "I hope that at a certain point we could merge with this part of the American program."

Proponents of the SSC also seek foreign

partners. DOE Secretary John Herrington speaks hopefully of sharing 25 to 50 percent of costs. SLAC's Burton Richter considers 15 to 25 percent more realistic. Even that substantial a contribution is unlikely, given the past track record of this country's participation in international projects. (*For more information, see page 4 of the January 1986 issue.*)

More recently, NASA has tried to restrict the kinds of research the European Space Agency and Japan will conduct on the "international" space station, even though these countries are contributing 20 percent of the cost of its development. Needless to say, this has rankled our Japanese and European partners. They find the Defense Department's desire to do military research on the station even more

offensive. As NASA Administrator James C. Fletcher remarked earlier this year, he found himself having to negotiate "adverb by adverb" to sustain a cooperative relationship.

The United States should fully face its need for research partners. Its tendency to dominate such partnerships is outdated. A new humility is in order. True partnerships mean sharing benefits as well as costs. And where the venture is pursuit of basic knowledge that no single country can afford, the benefits of partnership outweigh parochial concerns. If the United States wants to remain in the forefront of space research and high-energy physics, it should subordinate parochial tendencies to this larger purpose and seek all the international help it can get. □

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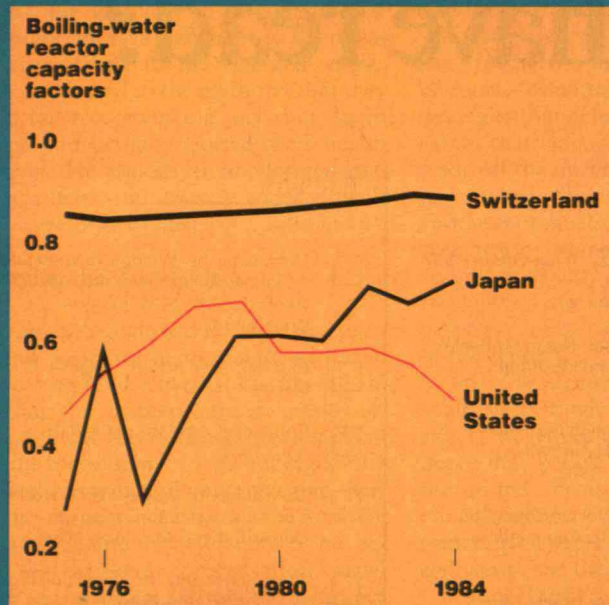
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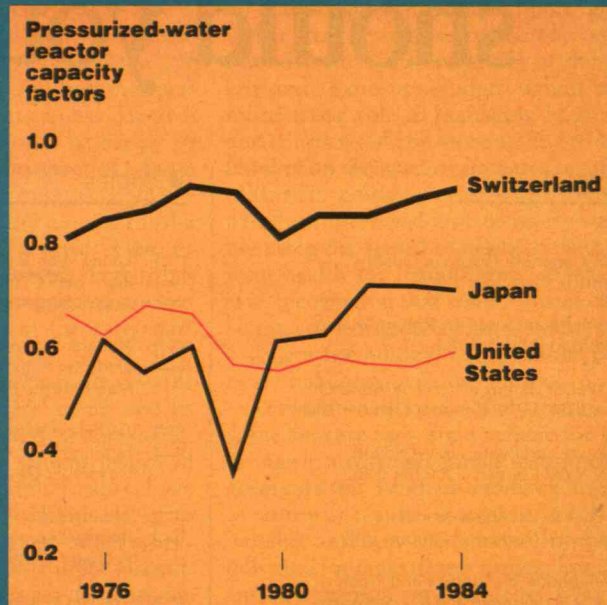
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Compared with their counterparts overseas, U.S. utilities have a lackluster record as operators of nuclear reactors. These charts, based on



M.I.T. analyses, show the 1975-1985 "capacity factor"—the ratio of the actual power generated to the total rated capacity of a country's reactors.

Nuclear Power: Advantage Overseas

To learn how to run a nuclear reactor, go to Switzerland. For the past decade the Swiss have been outstandingly successful in operating pressurized-water and boiling-water reactors—the two types commonly used in many Western nations, including the United States.

In three other countries with major nuclear capacity—Germany, Japan, and Sweden—reactor performance has been improving since the late 1970s. Only in the United States has the trend been flat or downward.

Professor Kent F. Hansen and four colleagues in the Department of Nuclear Engineering at M.I.T. and Technical University of Berlin use "capacity factor" as the index of performance—the amount of power actually generated compared to the total rated capacity of a country's reactors. They find that Swiss reactors have produced at 80 to 90 percent of capacity throughout the decade. In contrast, U.S. reactor performance has been between 50 and 70 percent, and the United States is

the only country in which nuclear electricity is not less expensive than fossil-generated power.

The M.I.T. study cites five characteristics that seem to contribute to the success of overseas operations: close and continuing ties between operators and suppliers, strong in-house technical abilities, continuous training and retraining of personnel, frequent personal contact between operators and regulators, and a sense among all parties that high performance is a norm. In addition, two factors unique to U.S. nuclear regulation may exert some influence on the performance of U.S. utilities, say Hansen and his colleagues: first, the ability of individual citizens to become directly involved in the regulatory process through the courts, and second, the significant antagonism between the industry and its regulators.

Detecting Radon

M.I.T. Professor Lee Grodzins and Daniel Perlman of Brandeis University have developed a passive device that is five times more sensitive than any other as a detector of radon—and ten times smaller. The de-

tector uses a small canister filled with activated charcoal that absorbs radon from the air. After four days' exposure, the charcoal is returned to a laboratory for analysis. Electro-Kinetic Systems, Inc., will market and support the device beginning next year.

Sweetener Danger

New evidence linking neurological disease with aspartame, the generic name for the artificial sweetener NutraSweet: laboratory mice made susceptible to seizures suffer them more frequently when fed aspartame, according to research by Richard J. Wurtman of the M.I.T. Department of Brain and Cognitive Sciences and Timothy J. Maher of the Massachusetts College of Pharmacy. There were no seizures in a control group of mice receiving no aspartame.

Questions about aspartame's neurological effects are long-standing, and Wurtman and Maher do not propose that this research resolves them. For example, the sweetener's effect on seizure-susceptible humans "will have to be explored in controlled clinical experiments," they say.



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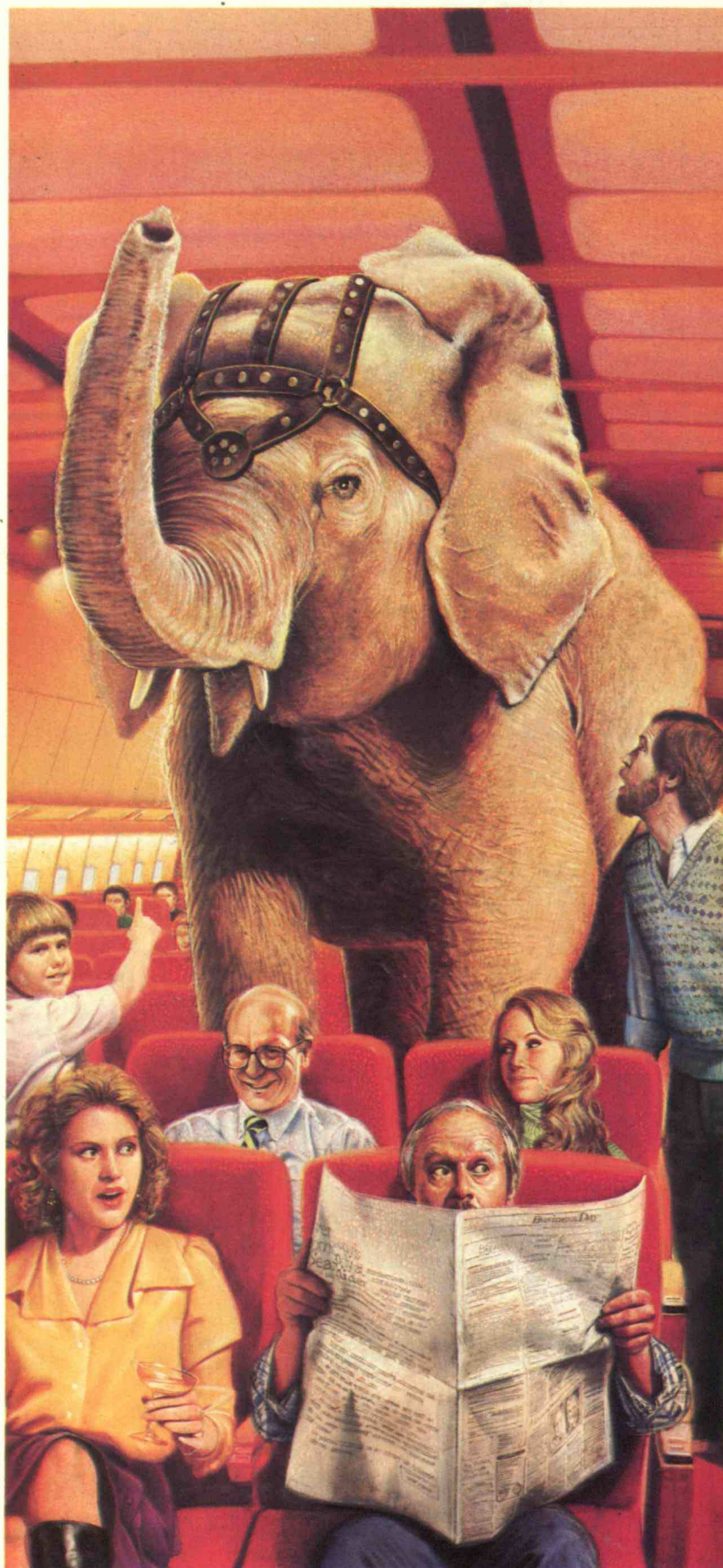
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